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ECONOMIC GEOGRAPHY

OCTOBER

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AN ECONOMIC FUTURE FOR JAPAN—George D. Hubbard

THE INDUSTRIAL DEVELOPMENT OF THE ALLEGHENY VALLEY OF WESTERN PENNSYLVANIA—E. Willard Miller

OUR MIDDLE AMERICAN TRADE—S. T. Emory

THE TUNG REGION OF CHINA—Yen Chiang-kwoh

CARNAUBA WAX IN UNITED STATES—BRAZILIAN FOREIGN TRADE
Grace Beckett

AN ISARITHMIC-DOT POPULATION MAP—John W. Alexander, U.S.N.R.

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ECONOMIC GEOGRAPHY

CONTENTS FOR OCTOBER, 1943

POCATELLO, IDAHO AS A RAILROAD CENTER 325
ROBERT WRIGLEY, JR.

BULGARIA'S MODES OF TRANSPORT 337
KIMON A. DOUKAS

THE SPANISH MOSS INDUSTRY OF LOUISIANA 347
C. C. ALDRICH, M. W. DE BLIEUS, AND F. B. KNIFFEN

THE MIGRATION AND SETTLEMENT OF DETROIT MEXICANS 358
N. D. HUMPHREY

THE GEOGRAPHY OF CRAB ORCHARD: A SUBMARGINAL AREA IN SOUTHERN ILLINOIS 362
JOHN L. PAGE AND EUGENE MATHER

CURRENT ASPECTS OF AMERICAN AGRICULTURE 372
WILLIAM I. MYERS

AN ECONOMIC FUTURE FOR JAPAN 380
GEORGE D. HUBBARD

THE INDUSTRIAL DEVELOPMENT OF THE ALLEGHENY VALLEY OF WESTERN PENNSYLVANIA 388
E. WILLARD MILLER

OUR MIDDLE AMERICAN TRADE 405
S. T. EMORY

THE TUNG REGION OF CHINA 418
YEN CHIANG-KWOH

CARNAUBA WAX IN UNITED STATES—BRAZILIAN FOREIGN TRADE 428
GRACE BECKETT

AN ISARITHMIC-DOT POPULATION MAP 431
JOHN W. ALEXANDER, U.S.N.R.

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EDITORIAL

EXIGENCIES of publication, consequent upon the impact of the war emergency, force the reduction in page number of the issues of ECONOMIC GEOGRAPHY for 1944. Dearth of manuscript, limitations upon use of paper, and labor deficiency have conspired to delay the issues of this volume of the magazine and to curtail the text of subsequent issues, until the end of the war comes to improve the present difficult situation.

The schedule of publication, it is hoped, will early be restored to its original dates. Though the numbers will be temporarily smaller, they will present the same type and quality of material as before. As manuscripts come in more freely, the shortage of paper is overcome, and labor becomes more abundant, the magazine will resume its regular size.

ECONOMIC GEOGRAPHY

VOL. 19 OCTOBER, 1943 No. 4

POCATELLO, IDAHO AS A RAILROAD CENTER

Robert Wrigley, Jr.

POCATELLO is a major railroad center of the Intermountain West. It is a key point on the Union Pacific, the only rail-line serving the principal populated areas of southern Idaho. Annually it handles a large volume of railroad traffic. By virtue of the city's position on its lines many Union Pacific activities have been localized in this community of twenty-one thousand population. Here is the headquarters of the railroads, the Idaho Division which includes the lines between McCammon, Idaho and Butte, Montana, and between Granger, Wyoming and Huntington, Oregon (Figure 1). Here are the largest Union Pacific shops between Cheyenne and the coast. Here also are a general storehouse, a tie treating plant, an icing plant, and other railroad facilities. Since this industry in normal times engages approximately 2,800 workers or 34 per cent of the gainfully employed persons in Pocatello, or considerably more than any other occupation, it is the city's dominant activity. This proportion of persons in railroading is thought to be unusually high for a town the size of Pocatello. The extent to which this is true illustrates the city's strategic position in the railroad pattern of eastern Idaho (Figure 1).

Eastern Idaho and its Railroad Pattern—The principal farming districts in eastern Idaho are located near the southern edge of the Snake River Plain. In this section water from Idaho's master stream, the Snake River, and a number of tributaries, has been impounded and diverted to irrigate thousands of acres of rich farm land (Figure 2). In no other part of eastern Idaho, and indeed few places in the Intermountain West, is there such favorable association of land and water resources as on the Snake River Plain.

The irrigated country near the Snake River, frequently called the "Snake River Valley," may be divided into two segments, the Upper Snake River Valley and the Central Snake River Valley (Figure 2). The Upper Valley extends roughly from Pocatello northeastward about 100 miles to the vicinity of St. Anthony. The Central Valley lies 70 miles southeast of Pocatello in the vicinity of Burley and Twin Falls. These two irrigated sections are the principal crop producing areas of eastern Idaho. Naturally they have a comparatively dense population. In fact three-quarters of the persons in this part of Idaho reside in the Snake River Valley. The population of the Upper Valley, including Pocatello, approximates 100,000 persons while the Central Valley has some 80,000 inhabitants. Elsewhere throughout the territory the land is sparsely peopled and is used

largely for grazing but there are also scattered patches of irrigated and dry farm land. All in all the farming and range areas in that section of Idaho southeast of the plain support about 36,000 persons while the narrow mountain valleys north of the plain include approximately 18,000 persons.

The railroad lines through eastern Idaho are widely spaced but on the whole they serve most people in the territory adequately. The Union Pacific

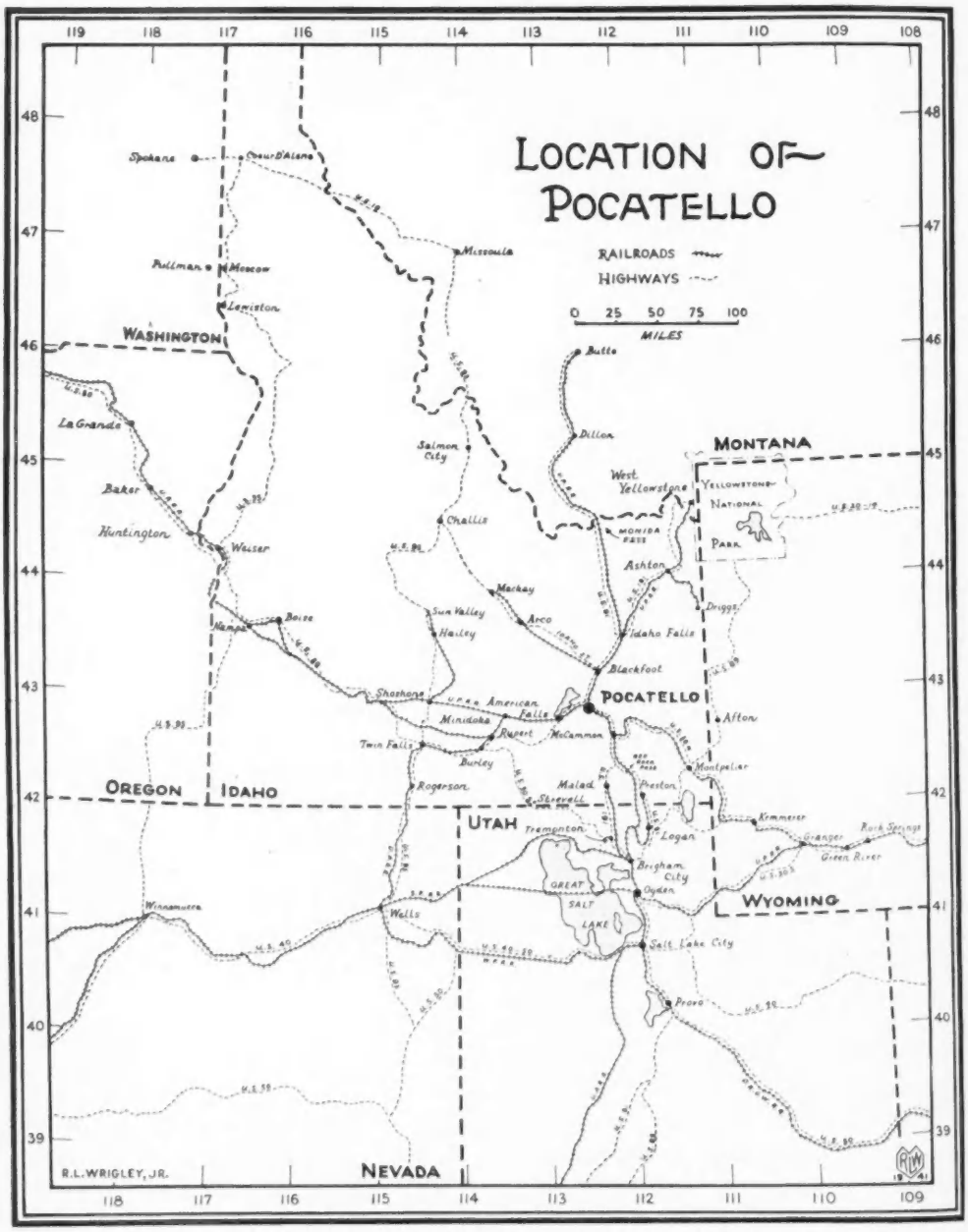


FIGURE 1.—Pocatello lies approximately 170 miles north of Salt Lake City and 260 miles south of Butte, Montana. Note that the pattern of principal highways coincides, to a large degree, with the major rail lines.

has two main lines across the state. One line extending west from Granger, Wyoming through the Bear River and Portneuf valleys and across the Snake River Plain to Portland, Oregon is part of a main transcontinental route. The other line extends north from Salt Lake City through Red Rock Pass, the Marsh and Portneuf valleys, and across the Snake River Plain to Butte, Montana (Figures 1 and 3). Between Pocatello, on the edge of the Snake River Plain, and the small town of McCammon, 23 miles to the southeast these two routes run parallel through the Portneuf Valley. At Pocatello

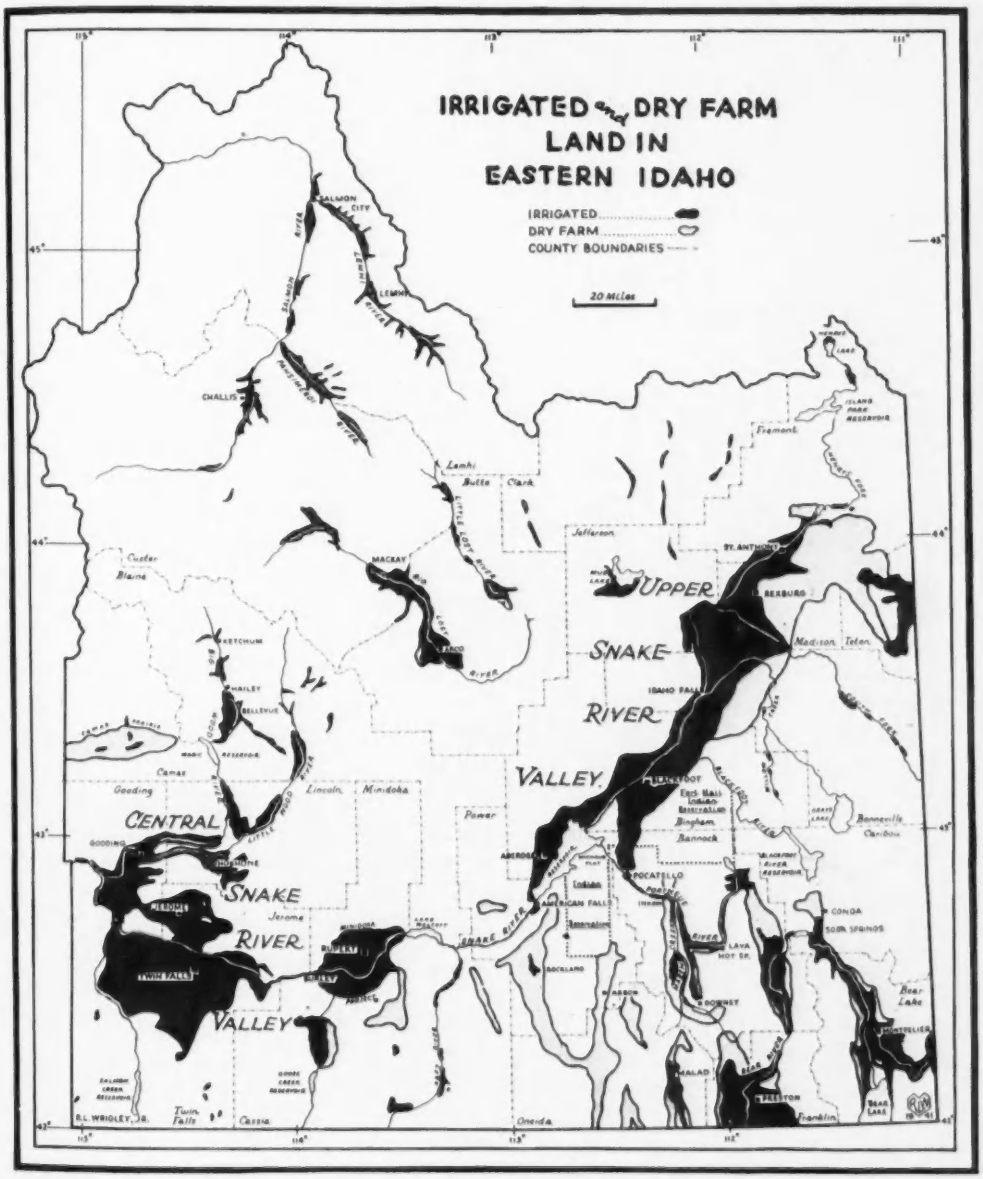


FIGURE 2.—Patches of irrigated land are scattered widely throughout eastern Idaho but the chief irrigated tracts are found near the southern edge of the Snake River Plain. The Rexberg Bench east of the town of Rexburg is the principal dry farming section.

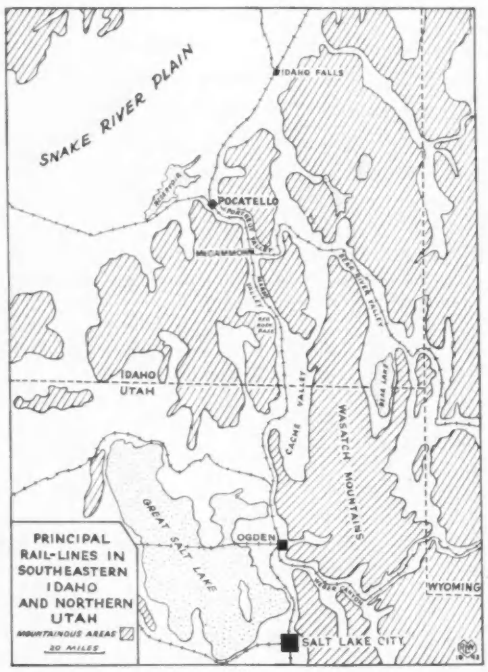


FIGURE 3.—Through the Portneuf Valley two important rail-lines reach Pocatello and the Snake River Plain.

the line to Butte turns north and passes through part of the Upper Valley, while the line to Portland swings to the southwest. The latter road is built north of the main portion of the Central Valley, but this and other farming districts not on or near the main lines are connected to them and thus to Pocatello by numerous branches.

Focal Position of Pocatello in the Railroad Pattern—For approximately 325 miles north of Ogden, Utah there is only one good railroad route across the Rocky Mountains and that is the route followed by the Union Pacific through the Bear River and Portneuf valleys. Furthermore the north-south route through Red Rock Pass and the Marsh and Portneuf valleys offers the lowest grades from Utah to the Upper Snake River Valley and Montana (Figure 3). The Portneuf Valley is thus a major transportation corridor in the Rocky Mountain area. Pocatello, located on the edge of the plain and at the western end of the valley, therefore, lies at the intersection of two important rail routes (Figure 1). Since the city is the eastern portal to the Snake River Plain, the heart of the state, virtually all imports from and exports to the east by rail from this part of Idaho move through Pocatello. Because of this commanding position Pocatello long has been called the "Gate City" of Idaho. But in addition to the Idaho freight much traffic between the east and the Pacific Northwest also passes through Pocatello. Considerable traffic likewise moves between Idaho and Montana and points south of the city. Pocatello is thus a bottleneck of rail traffic with approximately 858,000 cars passing through its terminal district in 1940. The heavy freight movement has resulted in fast and frequent service to Pocatello from many points. Naturally this aids the development of manufacturing and merchandising enterprises in the city. It also has made Pocatello a good center for railroad repair work. In view of the city's position on its lines it is not surprising, therefore, that the Union Pacific over a period of sixty years has localized many of its activities at this point.

Evolution of Pocatello as a Railroad Center—The first railroad built through Pocatello, and indeed into the Idaho Territory, was the Utah and Northern. This narrow gauge line, constructed in the years 1872–84, extended from the Union Pacific Railroad at Ogden, Utah approximately 466 miles northward to a junction with the Northern Pacific at Garrison, Montana. The Utah and Northern was built primarily to supply the western Montana mining fields with rail facilities. In general it was constructed along the same route now followed by the Union Pacific line between Ogden and Butte.

Work on the Utah and Northern began at Brigham City, Utah in March 1872. Due to adverse economic conditions and to inadequate financial backing, however, construction was delayed. Though the various sources of information do not agree it appears that the line was built to Pocatello by August 1878. It was completed to Butte in 1881 and to Garrison, Montana in 1884.

From the vicinity of Red Rock Pass, about 25 miles north of the Utah-Idaho boundary, to the crossing of the Blackfoot River, or a distance of 70 miles, the Utah and Northern traversed the Fort Hall Indian Reservation (Figure 4). This reservation, established in 1869, comprised about 1,300,000 acres. As the Pocatello townsite was included in this reservation the railroad officials chose Eagle Rock (Idaho Falls), a small community on the Snake River 27 miles north of the reservation, as their main repair and administrative point in eastern Idaho.

The real beginning of Pocatello awaited the construction of the Oregon Short Line Railway. After a careful investigation of possible routes this standard gauge line was built across southern Idaho into Oregon by the Union Pacific Railroad Company. Work on the Oregon Short Line commenced at Granger, Wyoming in May 1881. The road was pushed forward rapidly using practically the same route west of Granger that it follows today. By the autumn of 1882 the line was completed to Pocatello.

The management of the OSL, as it was called, wanted to establish divisional headquarters at McCammon because several hundred acres at this site appeared to have been withdrawn from the Indian Reservation (Figure 4). The railroad thought it would be easier to secure this privately owned land than to negotiate with the government over Indian land. The company, however, was unable to secure the McCammon property but it was successful in purchasing forty acres of Indian land and establishing a division point at Pocatello which thereby became the junction of two important transportation arteries (Figure 5).

Officials of the Union Pacific, sensing the strategic importance of the site and the future possibilities of the territory, early began to broaden their activities at Pocatello. Year by year it became more and more important as a center to handle running repairs and as a fuel and water station. Seeing that the Union Pacific controlled the Utah and Northern and that Pocatello was the logical site for repair shops to serve both railroads, the Utah and Northern shops were moved from Eagle Rock to Pocatello in the summer of 1887. Since traffic through southern Idaho was increasing Pocatello naturally benefited from this move. About this time also the Utah and Northern was being rebuilt to a standard gauge.

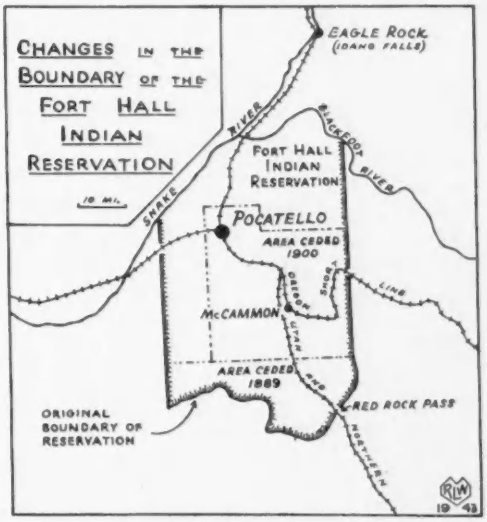


FIGURE 4.—Pocatello is closely bounded on the north and west by the Fort Hall Reservation. The Indian land on the Snake River Plain north of Pocatello partially is farmed; elsewhere the reservation is used chiefly for grazing.

FIGURE 5.—Station grounds at Pocatello about 1884 looking toward the southeast. Railroad employees lived in the houses at the right. Note the road bed with three rails.

During the decade 1880 to 1890 irrigation farming in the Upper Snake River Valley grew considerably, but on the whole the territory remained sparsely settled and consequently furnished the railroad little revenue. Most traffic through the city was destined for, and originated in areas outside eastern Idaho. In order to handle this traffic extensive repair shops, a supply depot, an ice house, and other railroad facilities were built in Pocatello. As a result by 1900 the city had developed into a major railroad center of the intermountain country with a railroad plant that, to a large degree, has retained the same general characteristics to the present day.

Adjustment of the City to the Railroad Layout—The railroad plant, which consists primarily of extensive transfer and storage yards and impressively large repair shops, extends across the center of Pocatello and bisects it into two sections (Figures 6 and 7). These sections, called the East Side and the West Side, are about equal in population. As a true expression of its significance to Pocatello the Union Pacific facilities constitute, therefore, a central core around which lie the residential areas of the city as well as two rather well defined commercial areas, the Business District and the Wholesale District (Figure 6).

Pocatello's built-up sections spread out over the relatively flat floor of the Portneuf Valley which in this locality merges with the Snake River Plain. Houses are built up to but not upon the dissected benches and hills that border the city on the east and west. Mountains rising at various distances beyond the benches rim the city on all sides except toward the north and northwest where lies the broad and flat-appearing Snake River Plain.

The built-up sections of the city are tied together by a checkerboard street pattern with streets parallel and perpendicular to the railroad yards. Although quite uniform throughout the city this pattern is altered somewhat in the Village of Alameda which adjoins Pocatello on the north (Figure 6).

The railroad yards interrupt cross-town travel on all streets except three. Naturally these three streets, since they bind together the two sections of town, are highly important in the pattern structure of Pocatello. Of the three crossings the most important by far is the Center Street subway which joins part of the Business District, built up along east Center, to the main business section lying adjacent to but west of the tracks. The second commercial area,

the Wholesale District, is located along the eastern edge of the terminal district in the southern part of the city (Figure 6). This concentration of business structures beside the busy railroad terminal whose many tracks often are crowded with long lines of freight cars, together with the close proximity of the big railroad shops, which spread over a fifty-acre tract directly north of the Business District, gives the business heart of Pocatello a size and tempo not found in other Idaho cities.

Railroad Traffic Through Pocatello—Within the railroad pattern of southern Idaho, Pocatello functions chiefly as a repair, transfer, fuel, and administrative center for the Union Pacific. The degree and diversity of the city's railroad work is related closely to the volume and nature of the traffic within and through the Idaho Division of the Union Pacific. Heavy traffic requires extra men to operate and service trains and to repair the road bed, the rolling stock, and other equipment. Conversely, a decrease in traffic curtails railroad work. Furthermore, a change in the nature of the items shipped also affects employment because to care adequately for perishable commodities and livestock requires additional equipment and labor.

Traffic through the Idaho Division of the railroad, even though it does not pass through Pocatello, has a marked effect on the city's railroad work. But that traffic handled by the Pocatello Terminal District has a much greater influence on railroad activities. This includes the shipments through as well as traffic originating and terminating in the city.

The traffic flow is made up of freight and passengers but the former movement is by far the most significant. Pocatello is neither big enough nor are its industries of sufficient size to supply the railroad with large shipments. Moreover, since its vicinity is little used agriculturally the city does not forward a large volume of farm commodities. Thus in 1940 only 6,840 cars were received at and 1,461 forwarded from Pocatello. On the other hand it will be recalled that in that same year a total of 858,000 cars were checked through the Pocatello switching yards.

The heavy flow of traffic has developed because the lines through Pocatello connect areas producing different types of commodities. Southern Idaho and other territory, north and west of Pocatello that is served by the Union Pacific, produces an excess of farm commodities, livestock, forest products, and minerals. Such production illustrates the utilization of irrigation, range, and forest land, and of mineral deposits which are the greatest resources of the region. On the other hand this area is deficient in manufactured goods. Such merchandise must be imported primarily from the great industrial centers of the

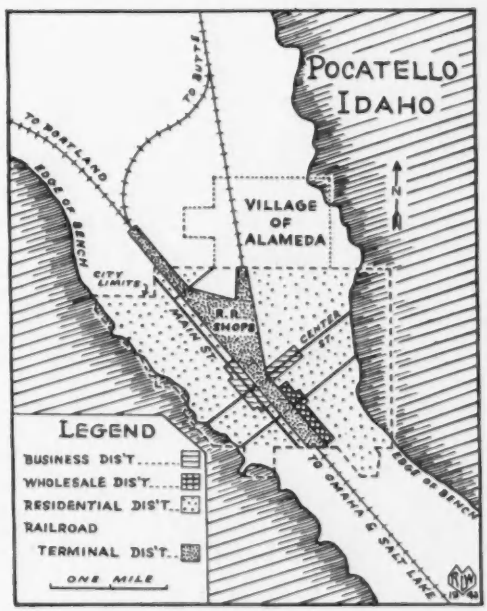


FIGURE 6.—The Railroad Terminal District occupies about twelve per cent of the townsite. The benches and hills bordering the city are virtually unutilized.

middle western and eastern states. There is a surplus of manufactured articles but a deficiency of foodstuffs, forest products, and mineral in the latter sections, hence there is an exchange of goods. The east-west flow of traffic through the city is much greater than the north-south shipments, yet the trade is not balanced directionally because in most cases the commodities exported to the east are more bulky than the return flow of manufactured goods. In fact east-bound traffic is roughly one and one half times as great as west-bound traffic.

Of the wide variety of agricultural products shipped eastward through Pocatello vegetables and fruit are especially important. Potatoes, lettuce, onions, green peas, apples, and plums move east from the Boise section and other parts of western Idaho. A sizeable volume of fresh and canned vegetables and fruit likewise come from Oregon and some even from Washington. Potatoes and dried beans are leading exports from the Snake River Valley. The highly advertised potato crop is the chief contribution of eastern Idaho to the freight flow through Pocatello with approximately 32,000 cars of potatoes passing through the city in 1939. These heavy shipments, which move to a nation-wide market, not only employ many train crews and increase repair work at the shops by wearing out equipment but they also necessitate the establishment of special facilities to handle the cooling, heating, and ventilating of cars. Such equipment is maintained by the Pacific Fruit Express Company which is owned by the Union Pacific and Southern Pacific railroads.

Wheat and sugar are also of some importance in the traffic flow. But these commodities are not nearly as significant as the large exports of livestock and livestock products. The latter shipments reflect on the one hand the use made of the immense areas of grazing land, and on the other, the necessity of marketing the bulky hay crops by turning them into wool, meat, cheese, butter, and other commodities.

Forest products from western Idaho and the Pacific Northwest are a major article in the eastern flow of traffic since they account for upwards of one-fourth of the railroad shipments through the region. However, since the opening of the Panama Canal in 1915 part of this trade has shifted to the water route. A limited quantity of ore from the Wood River area of Central Idaho, and copper matte from Anaconda, Montana is shipped to Utah and California, but all in all this movement is not large.

The traffic moving north and west through Pocatello is made up of a wide assortment of manufactured articles and some raw materials that are shipped into southern Idaho and adjacent areas to satisfy particular needs of the population in this territory. Shipments include agricultural implements, automobiles, automobile supplies, road equipment, furniture and other household goods, canned foods, meat, meat products, semi-tropical fruits, and coal and petroleum products. The latter items are especially important, for Idaho produces no petroleum and virtually all coal must be imported.

Seasonal Nature of Railroad Employment—Since agricultural commodities are the leading items in the traffic flow through southern Idaho, and since most crops are harvested in late summer and autumn, the heaviest car movement occurs at that time of year. During these months and especially during October the railroad must hire from 300 to 500 extra hands in Pocatello. This seasonal work is a disturbing factor in the local economy because the extra railroad employees are dismissed about

the same time as merchants start cutting their payrolls. When not employed by the Union Pacific many part-time railroad men find jobs in other industries in Pocatello or in other cities, but at best their work is unsteady. The problem is eased somewhat by the fact that it is the younger and less experienced workers who are laid off first. During their period of unemployment these men may live with their parents. Unemployment compensation is another factor relieving this condition. Nevertheless, the seasonal nature of railroad employment has discouraged many promising young men from entering railroad work and the industry thereby has suffered.

FIGURE 7.—Pocatello and part of the Snake River Plain looking toward the northwest. Compare this photograph with figure six and note the location of the various districts. (Courtesy of Thomas Barrett, Pocatello.)

Railroad Activities in Pocatello—The 2,800 persons normally working for the Union Pacific at Pocatello are engaged in diversified activities, yet certain branches of the company operations require many more employees than others. The repair shops are the most important phase of the railroad work. As a rule they employ around 800 persons. Extra workers engaged during the autumn months number 200 to 250; these figures, however, vary from year to year. Passenger and freight crews working out of the city together with the crews transferring cars within the Pocatello Terminal District include approximately 690 men. Work at the passenger and freight depots requires almost 200 persons while the general storehouse, the Pacific Fruit Express Company, and the tie treating plant altogether employ approximately 290 workers. In addition some 600 to 700 persons are engaged in line repair work and other activities. Employment in the latter branches of the railroad work also fluctuates during the year and from year to year.

The railroad shops—the most prominent feature of the Pocatello railroad plant—are a concrete expression of the position of the city as a railroad center (Figure 8). The principal function of these shops is to make running repairs and do general overhauling for all types of equipment used on the Idaho Division, but inasmuch as they are the largest and best equipped Union Pacific shops west of Cheyenne, they also overhaul considerable equipment from all sections of the road west of Granger, Wyoming. The fact that the railroad has enlarged this plant from time to time over a period of more than fifty years is indicative not only of the growth of southern Idaho and adjoining territory but also of the strategic position of Pocatello on its lines.

The terminal yards that form such a prominent feature of the Pocatello landscape and that have influenced profoundly the pattern of the city, function as transfer and storage yards. Activity in these yards frequently is at a high tempo because very few trains arrive at Pocatello that do not require the transferring of some cars. Switching work in February 1941, for example, required the continuous service of twelve engines. Naturally additional engines are required to handle the heavy traffic during October and November. Obsolete as well as modern equipment that is not in service is stored at this point because a reservoir of rolling stock maintained here can be shifted conveniently in several directions when needed.

As early as 1895 Pocatello had a railroad supply depot but the scope of this work was greatly expanded in 1923. Because of its strategic position on the railroad, the city is a good location for an organization whose function is to assemble, store, and distribute all types of railroad supplies except food and clothing. Over forty thousand items shipped from all parts of the nation are kept on hand. Through the medium of supply trains various points on the Union Pacific Railroad west of Granger, Wyoming are served once a month.

The passenger depot in the West Side Business District and the freight depot in the Wholesale District house important railroad activities. Administrative work for the Idaho Division has offices in the passenger depot. This building, therefore, is the nerve center from which railroad operations in most of southern Idaho and part of western Montana are directed. Before automobile transportation assumed large proportions the depot was the principal gateway to the city. Now, however, most passengers on the thirteen trains that arrive and depart daily are through passengers who seldom get beyond the depot. But in so far as the operation and servicing of these trains and the repairing of their equipment requires considerable labor, the city benefits. The administration of local freight, which employs almost one hundred persons, is centered in the freight depot. The location of this terminal in the Wholesale District is convenient because it affords ample room for the handling of trucks. Furthermore, the transfer and storage concerns, which distribute much of the merchandise coming through the depot, have their headquarters in the Wholesale District.

The Pacific Fruit Express Company maintains eight icing plants conveniently located along the main lines of the Union Pacific. One of these plants is in Pocatello. As most perishable commodities are moving east through the city this plant has been built northwest of town so that cars may be iced before trains move into the main yards. From May

to October approximately twenty-five thousand tons of ice manufactured in this plant are used for the initial icing of perishable commodities loaded in and around Pocatello and for the re-icing of loads in transit through the city. During the late autumn and winter months, when the movement of perishables reaches a peak, the cars must be heated; and at all times their ventilation must be checked carefully. In addition empty cars must be cleaned and prepared to receive new loads. Aside from the refrigeration division this company operates three other departments. The car service department administers the movement and servicing of cars through the city. The store department maintains a stock of supplies used by the company, while the car department handles light running repairs.

The tie treating plant, located northwest of the city, is another significant unit of the railroad operations. From September to April this establishment employs about fifty persons with some part-time help, but usually it is closed during the summer months. Whether or not there is a shut-down, of course depends on the demand for ties. Before this plant was erected in 1921 the western section of the road used a small number of ties treated at its Los Angeles plant, which now is closed; but most of the lines were tied with untreated timbers. The untreated material, however, lasts only a few years, whereas the treated ties last from twelve to fifteen years. During the autumn and winter months about seven hundred thousand ties are shipped into Pocatello from western Idaho and the Pacific Northwest and treated. As spring and summer is the season for renewing ties, distribution takes place at that time of year. The section of the railroad from Butte, Montana to Los Angeles and east of Pocatello to Rawlins, Wyoming

FIGURE 8.—Pocatello railroad shops. The fifty-three stall round house is one of the largest operated by the Union Pacific Railroad. (Courtesy of Thomas Barrett, Pocatello.)

receives its ties from the local plant, whereas that part of road west of Pocatello, with the exception of several branch lines in southern Idaho, is served from the plant at The Dalles, Oregon. The lines east of Rawlins receive their ties from Laramie. Returning coal cars are used to haul the untreated ties to Pocatello. This movement, therefore, works in nicely with the coal trade. Doubtless this was one factor contributing to the development of a tie treating plant at Pocatello, another being the accessibility of the city to a large section of the railroad.

Conclusions—The growth of agriculture and industry in southern Idaho, the Pacific Northwest, and western Montana has created additional business for the Union Pacific. Of course railroad activities in Pocatello have benefited from this development. But due chiefly to technical improvements in equipment, to increased efficiency in operations, and to competition with highway transportation the number of railroad employees in the city increased very slowly between 1920 and 1940. On the other hand retailing, manufacturing, and other occupations grew considerably during these years. In 1940, for example, the retail and wholesale trade, manufacturing, and public service activities, in the aggregate, engaged as many persons as the railroad. In terms of employment, therefore, railroad work in Pocatello is comparatively less important now than in former years. In other words, Pocatello, though still dominated by the Union Pacific, is less of a "one industry" town today than twenty or thirty years ago. No doubt within the near future the Michaud flat, a fertile and level tract of about thirty thousand acres located a short distance west of the city, will be utilized for irrigation farming. With this development the trend toward a more even distribution of employment in numerous activities should continue. Pocatello, therefore, will have evolved from a community entirely dependent on railroading during its early years to one with a well rounded occupational structure. In consequence it should play a more significant role in the life of the region in which it is strategically situated.

BULGARIA'S MODES OF TRANSPORT

Kimon A. Doukas

Introduction

BULGARIA'S economic history begins with the unification of the two halves of the country in 1885. At that time Bulgaria had a territory of 96,345 square kilometers, a population of slightly over 3,000,000, a railroad track of 693 km. or 430 miles, and a highway system of 3,727 km. or 2310 miles. By 1913, her railroad track was expanded to 1,931 km. (1,197 miles) and her highways to 8,945 km. (5,545 miles)—a very considerable increase.

Her population on the other hand, having grown to 4,300,000 was 81 per cent rural; its principal pursuits were agriculture and livestock raising. Together these two accounted for about two-thirds of the country's total national income of 1,647 million gold francs, or 318 million dollars (as of 1911), which was divided as follows (in million dollars):

Agriculture	140
Livestock raising	40
Industry and handicrafts	37
Commerce	16
Securities	3
Real estate	22
Salaries not included above	60
Total	318

Leo Pasvolsky, *Bulgaria's Economic Position* (Washington, 1930), p. 24, note 3.

Public finances. Bulgaria's total budgetary expenditures during the period 1885 to 1911 increased from $9.7 million to $40 million representing an increase per capita from $3.6 to $9.2, or threefold increase. Outlays for railway construction and administration were increased proportionately, namely from $1.25 million in 1887, to $1.35 in 1900, to $1.2 in 1911.

These budgetary expenditures resulted in large foreign loans for two reasons: Bulgaria possessed little accumulation of liquid funds, and she was determined to promote at all costs internal development such as construction of railroads, highways, ports, telegraph lines, public buildings, schools, and essential military defense works.

Railroads

Distribution. As elsewhere, the configuration of the country dictated most of the routes chosen by the rail builders in Bulgaria, with Sofia, its capital, becoming the main rail center.

First, in southern Bulgaria, the route follows the valley of the Maritsa between the Balkan and Rhodope ranges across the fertile plains of Thrace as far as Adrianople, forming the Bulgarian section of the international trunk line. A branch line cuts across from Plovdiv (Philippopolis) to the port of Burgas on the Black Sea.

Second, in northern Bulgaria, another route runs as far as Varna across the high plains at the foot of the Balkans, and descends to the Danube ports, from Vidin in the west to (Rushchuk) in the east, most of which are connected with a number of branch lines. One of these lines connects Rushchuk and the port of Varna on the Black Sea.

Finally, a third route starts from Rushchuk and continues with many climbs and descents in a southward direction across the Balkans as far as

Stara Zagora, thus connecting the southern and northern lines, and then proceeds as far as Mastanli near the Greek frontier.

Trackage. The first line of 125 miles was built in 1873 and connected the Turkish frontier with Plovdiv and Sofia. It was extended to the Serbian frontier in 1888, comprising a total of 225 miles of track. The main trunk lines were laid out and completed between 1890 and 1910, with the exception of the line which crosses the Balkan ranges which was built between 1910 and 1913. There are five main lines, namely: The Sofia-Varna, the Sofia-Rushchuk, the Sofia-Burgas, the Sofia-Adrianople, and the most recent, the Sofia-Demir Hissar.

Yards, stations, depots, and a standard gauge line, connecting the Black Sea port of Varna and the Danube port of Rushchuk are double tracked. All other Bulgarian railroads are single tracked. As of 1938, the last year that official statistics were published in Bulgaria and made available abroad, Bulgaria's rail system comprised 1,809 miles of track of standard gauge, 128 miles of 76 cm. gauge, and 179 miles of 60 cm. gauge, all owned and operated by the autonomous State Railway Management or Directorate. Private undertakings owned and operated some 37 miles of narrow gauge track, of which 6.5 miles were operated by the state.

As of the year 1938, Bulgaria operated 5.26 miles of track per 100 square miles as against 3.61 per 100 square miles operated by Greece, 5.49 miles by Turkey, 6.13 miles by Rumania, 6.71 miles by Yugoslavia, and 11.90 miles by Hungary. Pre-World War I figures were: Bulgaria, 3.52 miles per 100 square miles, Austria 5 miles, Belgium 48.43 miles, France 6.40 miles, Germany 26.39 miles, Italy 10.52 miles, and the United States 8.73 miles.

As a whole, the Bulgarian railways were built in a very primitive way; economy and speed of construction were the main considerations, while the country's passes, defiles, and mountains presented insurmountable engineering difficulties. There are steep gradients, increasing the difficulty of operation and sharp curves, making any increased speed hazardous. Indeed, the average speed attained by Bulgarian railways never exceeds 25 miles per hour over the old lines, nor 35–40 miles anywhere. Low-grade line and ballast necessitates continuous repair; light bridges, of which some are reinforced by wooden scaffolding, hardly support heavy traffic and heavier modern rolling stock; old-fashioned stations provide little comfort and facilities, and inadequate shunting yards at junctions, particularly Sofia, Varna, Gorna Orchovitza, and Plovdiv, and too few and too short tracks at the stations, many trains thus being necessarily dispatched without full loads.

Construction. For a country the size of Bulgaria, it must be conceded that such a transportation system is of considerable importance. It seemingly contributes to her economic development and is adequately serving her national defense plans. The fact, however, remains that her railroads are in such poor condition that large amounts are constantly spent on repairs and improvements to make them meet even everyday needs.

Accidents. The maintenance of tracks and stations is inadequate and the operation in regard to rolling stock defective. Both combine to cause an excessive number of accidents and collisions, causing loss of life and waste in materiel. An analysis of the record in 1925, shows that there were:

a) 111 derailments in stations and 12 on the open track;

b) 29 collisions in stations and one on the open track;

c) 22 collisions with persons, animals, and carriages, nine runaways, and seven other miscellaneous mishaps;
d) 22 accidents of which 13 were partial derailments as a result of defective rolling stock; and
e) 54 rail breakages.

Personnel. In 1934, the year of the last census, there were 41,986 men and 1,403 women employed in all modes of transport and communication. The number of the railroad personnel was estimated at between 15,000 and 20,000.

In theory at least, the railroad employees are on tenure, having been assimilated with the civil service personnel. They have their own retirement fund to which they contribute eight per cent of their salaries, and are entitled to a pension calculated on the average salary of the six years preceding retirement, a pensioner to receive one fortieth of such average for each year of his total service, but in no case such pension to exceed 40 per cent of this average.

They are also granted a month's vacation annually with pay, a maximum of 180 days sick leave on full pay, which is an inordinately long period, subsidies in the form of bonuses for large families, and houses, which they rent from the administration at cost. Most of these houses were built after World War I by the management as an independent project. The cost was financed by a ten per cent special increase on ordinary passenger rates. Finally, they come within the provisions of the decree of 1919, which introduced in Bulgaria the eight-hour day and a forty-eight-hour week.

Equipment. In 1937, the rolling stock consisted of: 480 steam locomotives, of which 114 were engines with tenders; 51 diners; 541 passenger coaches seating 31,729 persons, all provided with vacuum brakes; 40 mail cars; 205 baggage cars; 3 refrigerator cars; 5, 163 flat cars; and 4,274 boxcars.

Traffic. Bulgaria's rail traffic, though not of large proportions, is increasing at a fairly steady rate, as the figures show (in millions):

Year	*Passenger-km.*	*Ton-km.*
1900	59	46
1910	120	112
1920	188	120
1925	233	208

Such increase in traffic, however, still remains below the volume of almost all her neighboring countries; only Greece and Turkey show a smaller volume of freight carried by their roads in proportion to their mileage. The following comparative table shows both freight and passengers carried during 1938:

Country	*Total mileage*	*Tons carried*	*Passengers carried*
Bulgaria	2,153	6,083,400	9,883,800
Greece	1,815	2,115,300	30,967,000
Turkey	4,366	4,013,500	23,266,000
Rumania	6,980	24,249,500	48,731,000
Yugoslavia	6,436	22,882,600	54,327,800
Hungary	5,381	29,213,000	109,335,800

Railway traffic in Bulgaria in both passengers and freight reaches its lowest point in January. It reaches its highest point in passengers in August, and in freight in October. It passes through 210 stations and 124 stops for passengers only, separated by an average distance of four to five miles. While passenger schedules are on the whole satisfactory, freight schedules are not; out of 20,000 freight trains in 1925 more than 4,000 fell behind schedule time.

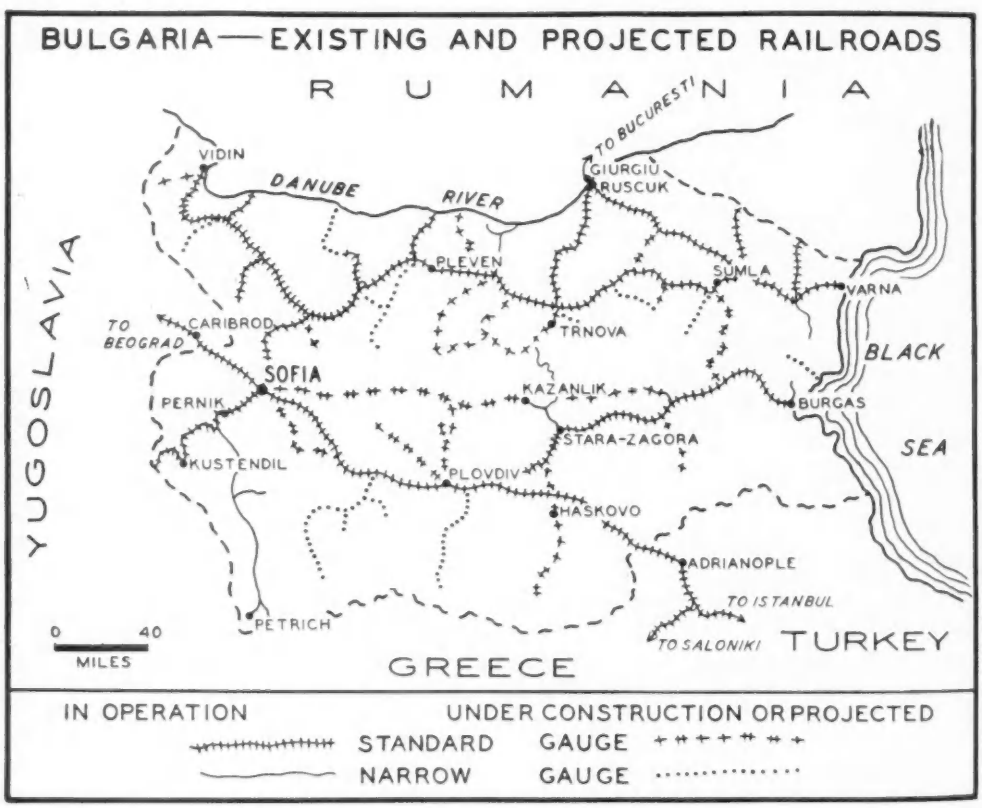
Freight consists of about 27 per cent in agriculture and livestock products, 18 per cent in coal and coke, 26 per cent in building materials, and 29 per cent in miscellaneous products.

Foreign loans. In building her railroads and ports, Bulgaria drew heavily on foreign investment. The first loan was placed in London in 1888 and pro-

vided for the repurchase from an English company of the railway line from Rushchuk to Varna. The loans of 1889 and 1892, both floated in Vienna, were partly for railway construction and partly for port development. Loans subscribed in France in 1902, 1904, and 1907, were mainly for transportation needs, with the exception of a fraction used for military equipment. Similarly, substantial portions of the two loans undertaken in 1909, one in Austria and the other in Russia, were used for transportation equipment.

All in all, during this early period from 1885 to 1911, Bulgaria had spent $62 million for the construction and equipment of railways and ports, and $55 million for supplementary public works—a total of $117 million as against the net proceeds of the above loans aggregating $94 million. The difference of $23 million was provided by the treasury through taxation.

League assistance. Under the post-World War I stabilization plan of the Bulgarian finances, undertaken under the auspices of the League of Nations, the Bulgarian government was authorized in 1926 to raise two loans abroad, one of £2,400,000 in London, and the other of $4,500,000 in New York. Part of the proceeds, not exceeding £1,250,000 or 845,000,000 leva (Bulgaria's monetary unit is the lev [pl. leva]. Before 1914, it was equivalent to 19.3 cents; by 1922, it had depreciated to 0.6835 cents; in 1926–1928, it was quoted at 0.725 cents. After its stabilization in 1930 at 92 leva to one gram of fine gold, quotations varied from 1.5 cents one lev in 1934 to 1 cent in 1938, to 1.21 cents in 1939), was earmarked for the improvement of Bulgaria's transportation, and M.



Regnoul, chief engineer of the French "P.L.M." rail system, was dispatched to Bulgaria in 1928 to look into her transport needs and formulate an overall program for the utilization of this sum. His exhaustive report became the basis of the rehabilitation of Bulgaria's transport system during the following decade. (See Publications of the League of Nations, *Bulgarian Stabilization Loan*, October 8, 1928, pp. 33–45.)

M. Regnoul first suggested the following expenditures which were aimed at restoring normal operating conditions (in million leva): repair of track and bridges, 204; repair of rolling stock, 35; new rolling stock, 111; safety apparatus, 13; stations, workshops, and depots, 205; a total of 568 million leva, or $4,118,000.

Second, he proposed the expenditure of 73,300,000 leva, or $530,000 for the completion of two short narrow gauge lines of approximately 28 miles each, both serving thickly populated and highly productive areas. One, extended the Sofia line terminal at Radomir to Dubnitza, and the other, completed the branch line from Yambol to Elhovo in the direction of the Turkish frontier. After their completion, these two lines were later (*circa* 1934–1935) converted to standard gauge track.

Third, he suggested that this total of $4,872,000 (including a sum of $225,000 for the ports), out of the available sum of $6,125,000, be spent on railway and port facilities over a period of five years. Though readily acceded to by the government, the Regnoul plan was not carried to completion because of the intervening world-wide crisis of 1930–1935. Likewise, another grandiose plan for the construction of additional lines of 1,000 miles at a total cost of about $25,000,000, proposed earlier in 1925 by the Railroad Management and subsequently authorized by the Sobranje, was still in the planning stage because of lack of funds.

Appropriations. Concurrently with these foreign loans, the government regularly included in the state budget an annual appropriation for both railways and roads. It averaged one million dollars a year, consisting of 10 per cent of the treasury collections from the land tax, augmented by the proceeds of exemption taxes paid in lieu of compulsory labor under the so-called "Stambolisky Law" passed in June 5, 1920. As amended, the law provides for compulsory labor service of all Bulgarian subjects, over 20 for men, and over 16 for women. An exemption may be purchased under the law of August 21, 1922, as amended. It lasts 12 months for men and 6 months for women, unless they are sole supporters for their families when it is reduced to half. It is administered by a Superior Labor Council, assisted by district councils and offices. This service is utilized by all branches of economic activity and public welfare, particularly in the construction of public works. The latest state budget of 1942–1943 included a lump sum of $8,000,000 to be spent on the improvement and maintenance of railways, roads, and water works.

In addition, the government reconsidered the old plans for railroad extensions and improvements submitted by the Railroad Management in 1925, had them redrafted in the light of modern needs, and finally submitted to the Sobranje a comprehensive plan which was approved as recently as May, 1943. Though scaled down to $20,000,000 for immediate railway development, this plan includes a 20-year electrification program, whose purpose is twofold; it will restrict the railroads' consumption of coal, now 350 to 400 thousand tons a year, and it will relieve

rail congestion, since approximately 25 per cent of the traffic consists of transportation of coal.

New lines. From the end of World War I up to 1942 new branch lines and extensions were built in Bulgaria at a total cost of $30,000,000; they consisted of 600 miles of track of standard gauge and 165 miles of narrow gauge. A number of these lines were conversions from narrow to standard gauge, such as the Radomir-Dubnitza and Yambol-Elhovo lines already cited.

Further railroad activity was initiated in connection with the exchange of populations between Greece and Bulgaria, concluded in the early twenties, when large construction projects were undertaken with the view of settling the Bulgarian refugees. One of these projects involved the construction of a new line from Haskovo, on the Sofia-Istambul express line, to Mastanli in the territory lying north of the Greek frontier. This line connected with a large number of cartroads which were constructed in some of the districts chosen for the settlement of the Bulgarian refugees; it was financed with refugee settlement funds.

Other branch lines were completed, or have been in the course of completion during recent years, namely: a) from Sinedel to Mourna, 24 miles of standard gauge, in the direction of Kazinlik; b) from Sarambey southward, 30 miles of narrow gauge, bisecting the Rhodope mountains and then continuing in the direction of Nevrokop; c) from Batanortzi to Kostinbrod, 35 miles of standard gauge, seeking to relieve traffic over the road from Sofia to Pernik; d) from Sofia eastward to Karlovo and Kalufer, 220 miles of standard gauge, and thence continuing on to Kazanlik from which it extends to Slivin on the Plovdiv-Burgas line. The greater part of this branch line runs along the Tunza river parallel to the Balkan and Anti-Balkan mountains; e) from Plovdiv to Karlovo, 47 miles of standard gauge; f) from Plovdiv to Panayaristi, where there are copper deposits, 50 miles of standard gauge; g) from Gorna Djumaia to Simetli, a conversion of 25 miles of narrow gauge to standard gauge on the Struma Valley line; h) from Simetli to Petritch and Kulata, 80 miles of standard gauge, extending the Struma Valley line and connecting with the Demir Hissar line of the Greek railways—a very recent extension.

Finances. As a separate state undertaking, the Bulgarian railways have, on the whole, been running at a loss; the difference between income and outgo is ordinarily met by the taxpayers through treasury appropriations. There are no complete figures as to the balance sheet of this public enterprise before World War I. As of December 31, 1914, its capitalization was given at $64,135,251, or $48,941 per mile. Its operations, on the other hand, showed:

Total operating revenue:		
From passenger traffic	$2,747,162	
From freight traffic	3,781,063	
Miscellaneous	201,492	$6,729,717
Total operating expenditures		4,321,849
Net operating revenue		$2,407,868
Operating ratio	64.22%	

In 1928, the League representative estimated the income and profit and loss for the year to be as follows:

Total operating revenue:		
From passengers and freight		$6,742,500
Total operating expenditures for:		
a) personnel and fuel	$1,740,000	
b) betterments	2,392,500	
c) new lines	529,250	
d) miscellaneous	1,138,250	$5,800,000
Profit		$942,500
Less fixed charges and amortization		1,450,000
Net loss or deficit		$507,500

Recent years. With the view of providing a more efficient financial administration, the entire railway system

of Bulgaria was reorganized in 1929 as an autonomous enterprise. Its financial operations were removed from the state budget; thenceforth only the annual profit and loss was to appear in the budget.

Only the following figures, therefore, for income and outgo of the Bulgarian railroads are shown in the 1938 budget:

Total operating revenue from passengers and freight	$13,138,000 or 625,000 per mi.
Total operating expenditures	9,217,000 or 438,000 per mi.
Net operating revenue	$3,921,000 or 187,000 per mi.

The capitalization was figured at 366,565,000 gold leva for permanent way and 101,539,000 leva for rolling stock, or a total of 468,104,000 gold leva, representing the large sum of 12,639,000,000 paper leva, or $126,390,000. No attempt is made here to estimate the amount, if any, charged for amortization and fixed charges on such a capitalization. The budget shows no such amount, except for supplementary credits granted during 1938 totalling $1,652,570.

On the other hand, the 1939 budget included the following estimates:

Total operating revenue from passengers and freight		$15,147,000
Total operating expenditures	$15,106,000	
Other costs	566,000	
Welfare service	93,000	15,765,000
Estimated loss		$618,000
Additional welfare service	133,000	
Construction of new lines	500,000	633,000
Net loss or deficit, not including fixed charges		$1,251,000

T. V. Brenan, *Report on Economic and Commercial Conditions in Bulgaria* (Department of Overseas Trade, London, May, 1939), pp. 46, 48.

International communications. It must be noted that up to recent years Bulgaria has had direct railway connections only with Turkey and Yugoslavia and countries beyond, via the international trunk lines of the Simplon-Orient Express and the Orient Express. Direct railway lines leading from Bulgaria to the neighboring countries of Greece and Rumania were totally lacking. As a result, her foreign trade with these two countries suffered and her national economy tended to become more and more dependent on distant markets, such as Germany's, with all the attendant economic and political consequences.

In regard to Bulgarian-Greek commercial relations, it must be noted that especially after World War I Bulgarian products, such as foodstuffs and coal, found a large and convenient market in Greece. Transportation difficulties, however, made the development of this trade almost impossible. In the absence of direct rail connections, Bulgarian coal, for instance, mined in the Petritch region not far from the Greek frontier, was dispatched to Greece by water in a roundabout way from Burgas to Salonica and other Greek ports. Linking the two rail systems would have been a comparatively simple matter both technically and financially and would have reduced distance and time in transport. Yet, because of political and military considerations, no steps in that direction could be seriously contemplated by the two governments.

Likewise, a bridge across the Danube connecting the port of Rushchuk with Giurgiu of Rumania would automatically bring together the Rumanian and Bulgarian railway systems. This undertaking, however, was opposed both on military and economic grounds, the latter consisting of insufficient Bulgarian-Rumanian trade to pay for the cost of operation alone. It was argued that the new line could carry enough traffic only if the Bulgarian railroads were also joined with the Greek railroads, thus affording a continuous direct flow of Rumanian products to Greek markets and beyond.

Recent developments. Both these proj-

ects were carried to completion as soon as the occupation of Greek Western Thrace was accomplished by Bulgaria, following the conquest of Greece by the Axis in 1941. It has already been noted above that an extension of the Gorna Djumaia line was joined with Demir Hissar, in Greece.

Recent reports from Rumania, on the other hand, state that one of the largest bridges in Europe is about to be built over the Danube by a German firm; it will connect Giurgiu with Rushchuk and will carry both motor and railway traffic. The bridge will supplement the train-ferry service between these two ports, established in 1940 under a convention signed between Rumania and Bulgaria on January 18, 1938. Bulgaria's ferryboat was built in Germany at a cost of $240,000, while shore installations at Rushchuk costing about $280,000 were carried out by the Bulgarian government.

PORTS

Black Sea. Bulgaria has eight ports on the Black Sea, of which only two, Burgas and Varna, the most important, are served by railways.

Burgas was completed in 1903; it is most conveniently situated in regard to the Bulgarian hinterland, and thus has superseded Varna in importance. Its traffic in 1925 totalled 112,000 tons of exports and 115,000 tons of imports. Varna was completed in 1906; it is losing in traffic because it competes with both the Rumanian port of Constantza and the Danube. Its traffic in 1925 was 126,000 tons of exports and only 44,000 tons of imports.

Both ports have inadequate warehouse facilities, their docks are in bad condition, they lack electric or steam cranes, and their piers have been settling to the extent of over two meters at certain points.

Shipping. The number of vessels of all kinds which arrived in 1938 at all the Black Sea ports was 9,349; their net register was 2,044,790 tons; they landed 229,542 tons of cargo and 42,921 passengers. The number of vessels which sailed from these ports was 9,320 of 2,031,161 tons net register; they carried 301,250 tons of cargo and 46,596 passengers. Of this traffic, 80 to 90 per cent was shared by Burgas and Varna.

Danube. On the other hand, Bulgaria has ten ports on the Danube. Though of relatively recent development, their upkeep has been considerably neglected since World War I. Their equipment, sheds, and stores are, generally speaking, inadequate. Likewise, the installation of beacons along the river in the Bulgarian sector, in accordance with existing international agreements, was not fully completed by 1938 because of lack of funds. The same was true of beacons along the coast of the Black Sea.

The most important of these ports are Rushchuk, Lom, Somovit, Sistov, and Vidin, all five served by railways. The traffic during 1925 in both imports and exports was given as 108,000 tons for Rushchuk, 93,000 for Lom, 31,000 for Somovit, 28,000 for Sistov, and 25,000 for Vidin.

Shipping. The number of vessels of all kinds which arrived in 1938 at all ten Danube ports was 13,152; their net register was 2,197,244 tons; they landed 142,894 tons of cargo and 108,237 passengers. The number of vessels which sailed from these ports was 13,115 of 2,187,834 tons net register; they carried 146,845 tons of cargo and 114,815 passengers. The busiest port was Rushchuk with 38.5 per cent of arrivals; next came Lom with 12.5 per cent, while Somovit, Sistov, and Vidin each registered from 8 to 9 per cent.

Total shipping. The bulk of the foreign sea-borne trade of the country is carried in foreign vessels: Austrian, British, Greek, and French ships are used. The aggregate traffic in cargo of all kinds entered and cleared aboard all types of vessels and boats through both Danubian and Black Sea ports amounted to 850,000 tons in 1936; it rose by 22 per cent to 1,036,000 in 1937, but declined by 13.4 per cent to 897,000 in 1938.

Improvements. In connection with the stabilization loan authorized in 1928 by the League of Nations, the sum of $225,000 was set aside for the improvement of technical facilities and other construction work of all Bulgarian ports, but primarily those served by railways. Additional construction work, though inadequate, was subsequently carried on through budget appropriations passed in the form of lump sums for the upkeep of railways, ports, and roads, already referred to above.

Merchant marine. Bulgaria possesses no merchant marine of any importance. The only steamship line worthy of the name is the Bulgarian Mercantile Steamship Company, Ltd., which, though privately owned, is heavily subsidized by the treasury. Its vessels trade between the Danube ports and the Mediterranean. In 1938, it consisted of nine vessels totaling 23,011 tons gross and 13,345 tons net register of a total carrying capacity of 30,000 dead-weight tons. Of these vessels, the S. S. Varna of 2,141 tons gross and 1,938 tons net register was acquired in 1937; the S. S. Shipka of 2,304 tons gross and 1,234 tons net register was acquired in 1938. Both were built by the Neptune Yard at Rostock at a cost of about £80,000 each.

In addition, the government has initiated, since 1938, a Danube passenger and cargo service by purchasing from the Danubian Steamship Building Company at Vienna three motor vessels, each designed to carry 700 passengers and 70 tons of cargo, at a cost of $340,000 each. Four other motor cargo barges, of 450 burthen each, were ordered from the Ruthof Yard at Regensburg at an approximate cost of $155,000 each.

ROADS AND HIGHWAYS

Length. Bulgaria possesses a fairly adequate highway system, though of little value for heavy transport purposes. Roads are of the macadamized type; only two per cent are granite paved or concrete surfaced. The total length as of 1938 was 18,938 miles, of which about 12,000 miles were county and local roads.

In relation to the highway systems of her neighboring countries, Bulgaria occupies a third place, being topped by Rumania and Hungary. The following comparative table shows both length and ratio, as well as unimproved mileage as of 1938:

Country	*Length*	*Of Which Unimproved*	*Per 100 Square Miles*
Bulgaria	18,938	7,663	47.57
Greece	5,148	(not given)	10.24
Turkey	25,656	15,286	8.71
Rumania	65,670	(not given)	57.66
Yugoslavia	26,047	25,426	27.16
Hungary	22,165	5,380	49.02

Maintenance. It must be noted that a large part of Bulgaria's roads are continually in bad repair. During and after World War I, many national highways were completely abandoned, especially in mountainous districts where good roads are sorely needed to supplement the scarcity of railroads. As a result, forestry undertakings and quarry enterprises had to be halted and the needs of the population were wholly neglected.

In his report to the League, M. Regnoul stated that even principal highways, such as the main arteries of Sofia-Svilengrad-Adrianople, and Sofia-Varna, had degenerated to tracks whose traffic was diverted on the neighboring land. He reached the conclusion that for months at a stretch during each year whole regions in Bulgaria found themselves completely isolated; deliveries to and from railway centers were rendered difficult and transportation was seriously interrupted. Owing to her financial difficulties, Bulgaria had neglected her highway system much more than her railroads. In comparison, local roads whose upkeep was borne mainly by towns and villages were found to be in a better condition.

League assistance. To restore her road system, M. Regnoul estimated that Bulgaria needed approximately $7,250,000. Failing that and as the first step in a long-range plan, he proposed that of the $6,125,000 stabilization loan about $1,250,000 be spent for repair and replacement of bridges, too often consisting of wooden structures, and for the completion of 150 miles of road under construction. Other appropriations in the state budget followed in subsequent years designed to keep the national highways in good repair. They were supplemented by cash exemptions from compulsory labor service under the so-called "Stambolisky Law" of 1920.

Yet, as late as 1938, in a report issued by the Ministry of Public Works it is stated that only about 6,000 miles of road, representing half of the entire system, were in "good" condition, that is, without holes; about 3,000 miles, or 27 per cent, were in an "average" state; the rest, about 23 per cent, were listed as "bad," that is, unserviceable even for pack traffic.

Appropriations. Annual expenditures for road construction and maintenance by the national government have averaged $1,000,000, including compulsory labor service. It is doubtful, however, that this sum is actually being spent on account of Bulgaria's chronic lack of funds.

Thus, the new international highway crossing Bulgaria from Dragoman near the Yugoslav frontier to Svilengrad and Adrianople via Sofia, which the government had long decided to build at an estimated cost of $6,000,000, was up to 1938 still proceeding very slowly, because of financial difficulties. From Dragoman to Plovdiv, the road is to be surfaced with granite and in part with concrete; from Plovdiv to the Turkish border, it is to be macadamized.

Recent construction. Latest reports from Bulgaria state that an old mountainous road connecting Bulgaria with Yugoslav ports on the Adriatic, often blocked in the past with snow from the mountains, has been replaced by a new, through, all-weather route over which traffic from Bulgarian cities and ports will move to the Adriatic ports of Durazzo, Albania, and Antivari, Yugoslavia. Also, that the latter port was declared a free zone for Bulgarian imports and exports during the recent Italian occupation under an agreement between the two governments.

THE SPANISH MOSS INDUSTRY OF LOUISIANA

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SPANISH moss is not only one of the unique and decorative features of the southern landscape, but a commercially important asset as well. It is the basis of a rather distinctive Louisiana industry, one that provides periodic or regular employment for many people of the state.

Growing on a variety of trees in the more humid portions of tropical and subtropical latitudes, Spanish moss is widely distributed in the Americas. It ranges from Texas to Florida and eastern Virginia in the Coastal Plain of the United States, and extends southward through the West Indies, Mexico, Central and South America to southern Brazil. Especially in swamplands whole forests stand ". . . festooned and draped with long, flowing beards of Spanish moss, misty gray and wraith-like in appearance, blending with, yet subtly hiding what lies beyond." (Figures 1 and 2.)

The plant has been known by numerous local names: long moss, black moss, Florida moss, crape moss, and wool crape. Early Louisiana settlers called it *Barbe Espagnol* or Spanish beard; the term Spanish moss has come into general use only in recent years.

Belying its name, it is not a moss at all, but a flowering plant belonging to the pineapple family, *Bromeliaceae*. Called originally *Tillandsia usneoides*, its accepted scientific name is now *Dendropogon usneoides*. If one examines the festoons of moss, he finds a tangled mass of stringy, spiraling stems, jointed every inch or so. The leaves are awl-shaped and in their axils are borne inconspicuous, fragrant green flowers, blooming in May and June. Formation of seed is slow, and dispersal is delayed until the following March. Although seeds are abundant, seedlings are uncommon and propagation is accomplished more frequently by fragments of festoons carried from one branch to another by winds or birds. When a piece of moss lodges on a limb, the living part of the stem in contact with the bark dies and sloughs off, leaving the inner fiber to hold the plant in place. Moss has great capacity for moisture, which is absorbed through tiny gray scales that cover every part of the stem and leaves, while dust dissolved in the water supplies the necessary salts.

Contrary to popular belief, Spanish moss is not a parasite, but is a true epiphyte, a plant deriving its sustenance from the atmosphere and lacking root connection with its host. Simple proof is found in the fact that it will live indefinitely on wires and fences. It is true that the plant is harmful to trees when the increased weight of rain-soaked festoons, buffeted by strong winds, causes branches to break. The moss, however, does not smother trees, as is commonly thought. An indirect cause of the belief that it is parasitic and therefore harmful, is its preference for sunny exposures, which tends to inhibit its growth on trees having dense foliage and to encourage it on dead or dying trees; the casual observer may confuse cause and result.

After proper treatment the inner fibrous portion of Spanish moss resembles horsehair, and like the latter it is tough, durable, resilient, and unlikely to lump. Because of these properties it

has long been used as filling or padding in a variety of manufactured goods, and herein lies its commercial importance.

The Louisiana moss industry is associated with the swamp areas, and these lie principally west of the Mississippi. Here the dominant forest associations are cypress and tupelo or red-gum and mixed hardwoods, depending upon minor differences of relief. Figure 3 shows the position of the major swamp forests. On the same map is shown the distribution of all the moss gins of the state. Since gins are located near the gathering areas, their positions are indicative of the localization of the industry within the general swamp region.

The exploitation of moss follows a well-defined course. It is picked in the swamps and cured on adjacent high ground. The gatherer then sells his product to a ginner who hauls it to the gin where it is graded, cleaned, and baled. Sooner or later, in accordance with market demand, the bales are shipped to factories in the north and east.

GATHERING

Moss is the money crop of an appreciable proportion of those Louisianians, black and white, who inhabit the fringes of swamps and the banks of bayous and canals. The bulk of the harvest is gathered in the spring, from February to June, but picking goes on to some extent throughout the year, particularly among those who depend entirely upon moss for their livelihood. Pickers are forbidden access to certain areas during the trapping season (November to February), while cane cutting and cotton picking deplete their ranks during late summer and early fall.

Picking privileges are generally gratuitous, without even the necessity of obtaining the landowner's permission. In some instances an individual is

FIGURE 1. Moss-bearing swamp forest. (Courtesy of C. A. Brown.)

granted gathering rights; a small fee may be involved. Logging operators have exchanged the privilege of gathering from felled trees for half the cured harvest.

Moss is gathered in a number of ways, employing various types of equipment. The easiest picking is that referred to above, which is carried on in the wake of logging operations. The moss supply of one district is now depleted because the pickers themselves felled the productive trees. But commonly moss is removed from standing trees or picked off the ground where it has been carried by storm winds. Practices vary regionally. In the Atchafalaya Basin (Figure 3), where the period from February to June is the high-water season, most gathering requires the use of boats. After a high wind the deeply-laden pirogues and bateaux resemble floating hay-cocks as they return bearing the easy harvest from shallow water. At other times the same pickers must employ "derrick" barges. These are scows on which are constructed pole towers extending up some fifteen feet (Figure 4). Equipped with a hook mounted on a long pole, the picker ascends to the tower platform from which he commands a reach of thirty feet or more above the water. The derrick barges are unwieldy in a high wind; not infrequently they tip over, dumping picker and hard-earned cargo into the water. During low-water stages, when the ground is no longer flooded, the picker moves afoot gleaning moss lodged in hollows and against trees. Along the Mississippi moss is largely ground picked; in one section pickers use spikes to climb up into the trees.

The amount of moss constituting a day's harvest varies with individuals and local abundance; hence it is impossible to strike a meaningful average for the whole state. Where moss is abundant (as in sections of the Atchafalaya Basin) a picker can gather 500 pounds daily. Better-than-average pickers are illustrated by the fourteen-year-old boy who collected 3,000 pounds in three days, and the man who gathered 1,100 pounds in six hours. At the other extreme are sections where 200 pounds is an excellent day's yield. Some idea of the harvest in an area of good picking is given by the case of a family of five who gathered 160,000 pounds in a year.

Curing: While much naturally-retted moss is gathered and some green moss is sold directly to ginners, most pickers cure their own harvest. Retting is an exceedingly important phase of moss production, having many aspects requiring keen judgment and much experience.

Curing or retting consists of treating the green moss so as to rot off the outer layer. The operation varies considerably in detail in different parts of the state, but the essential process is always the same. In some sections the green moss is buried in trenches or pits, where it is left until the cortex is dead and can be removed readily. As a more common practice it is piled in mounds or rows to a height of two feet in summer and five feet in winter (Figure 5). The mounds may be six feet or more square; the rows up to four feet in width. Generally, prior to piling, the moss is thoroughly and evenly wetted. It remains in the mounds or rows for from sixty to ninety days, according to the grade of finished moss desired. The pile may be turned once or twice, depending upon the progress of the curing. Following this two-to-three-month period the moss is hung up to dry (Figure 6). It may be turned once during the drying period, which lasts only twenty-four hours with good sunlight. At this stage the moss has lost

on the average two thirds of its original green weight. It is now ready for sale to the gin, although some gatherers grade their product prior to disposal, i.e., they separate it according to types demanded by the ginners.

It has been shown by experiments that the retting process (the rotting of the outer living layer or cortex of the moss) is due to the activity of micro-organisms. Three molds or bacteria have been isolated and identified as most significant. The molds are aided in growth and activity by the wetting and piling of the green moss. Heat, sometimes to a degree sufficient to burn the fibers, develops in the retting piles. The outer covering is bright green at one stage of the process, but it finally turns gray or brown and loosens its hold on the inner fiber, which has become progressively darker in color.

FIGURE 2. Moss on cypress trees; shore of Lake Pontchartrain. (Courtesy of C. A. Brown.)

Types of Moss: The qualities sought in retted moss are strength, darkness of color, and length of staple (the distance between joints). At one time moss was graded almost entirely on the basis of color, the darker colored bringing the higher price. It was found, however, that much of the dark moss was rotten, having been gathered from the ground where it had lain for years. At the present time color must share importance with the other qualities.

The expert grader notes color and staple length at a glance; he makes a simple hand test of strength. Almost as readily he can name the area and host-tree species from which the moss was gathered. The highest quality moss comes from cypress trees of virgin forests, now almost a thing of the past, where length of staple, color, and strength meet the highest standards. Festoons have been found measuring eighteen feet in length, a fact significant in its implication of luxuriant growth on old cypresses. Staple length is matched by moss growing on red or sweet-gum trees, but the latter rarely form solid forest stands, nor does moss grow on them in equal density. The

so-called hardwood mosses which compose the great bulk of today's production are definitely inferior in quality and quantity to those gathered from virgin cypress brakes.

As early as 1876, Dennett credited the Atchafalaya Basin with producing the best moss, a condition no doubt attributable to the dominance of heavy cypress forests growing in an atmosphere of high humidity. Even with second growth succeeding virgin forest, the Atchafalaya Basin contains the largest and most continuous stands of swamp forest, and so remains the most important producing section of the state.

Regrowth: The mention of production from second-growth forests immediately poses questions concerning the growth rate and quality of new moss on both old and young trees. Answers can be obtained only from those engaged in the industry. There is agreement that the best moss, both qualitatively and quantitively, is the virgin harvest from old timber stands. However, barring crown fires and the actual felling of trees, the rate of growth is such that the gathering of moss may be regarded as a permanent industry. One man has operated in the same area for eighteen years, while another area is still yielding after a forty-year period of exploitation. An inch a month was advanced as the normal rate of growth, which seems to confirm a statement that a

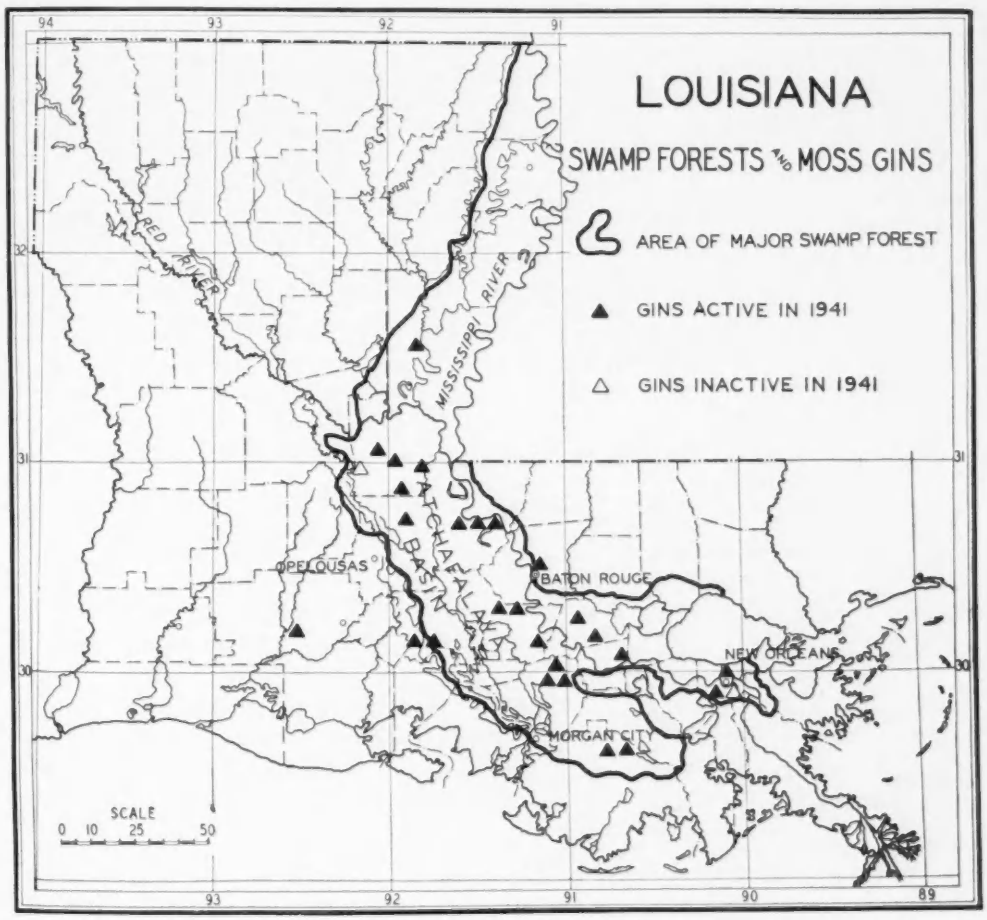

FIGURE 3. Map of Louisiana showing locations of principal swamp forests and moss gins.

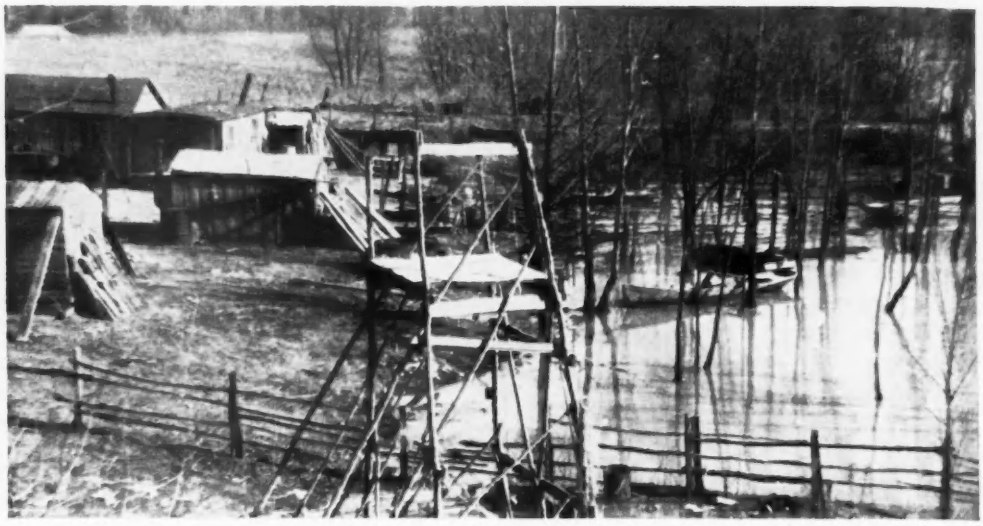

FIGURE 4. Settlement of moss gatherers on the eastern margin of the Atchafalaya Basin. In the foreground is the tower of a "derrick" barge. As indicated by the absence of foliage and submerged fences and trees, the picture was taken during spring high water.

two or three years' growth produces a new crop. In places of close forest stands the spread of moss to new trees is sufficiently rapid to assure a commercial yield by the time the tree has reached a size attractive to the gatherer. These estimates assume the customary method of picking, in which the tree is not stripped, but is relieved only of the most accessible and densest festoons, so leaving abundant sources of regeneration.

Prices: As with most other commodities, the monetary yield of moss fluctuates both with general business conditions and with variables peculiar to itself. Although the middleman ginner absorbs market changes to some extent, the income of the gatherer reflects seasonal demand, the competition of other areas and materials, the lack of organization of the industry, and, of course, his own knowledge and habits of work.

An extreme range of prices experienced by one veteran gatherer is from seventy-five cents for a hundred pounds of cured moss to a dollar for a hundred pounds of green moss. The average return for a pound of cured moss is two and a half to three cents. The quality of moss produced by the individual gatherer effects departures from the average price. With ordinary retted moss bringing two and one-half to three cents a pound, expertly cured moss, free from excessive moisture and trash, sells for four to four and one-half cents.

Peak demand and price come in November, when the picker may receive four and a half to five cents for a pound of cured moss. A sharp downward break follows the peak, with both demand and price climbing slowly upward on the next annual cycle.

There is no statistical information on which to base a reasonable estimate as to the annual income of one whose only occupation is moss gathering, nor is there information regarding the proportionate income of those who engage in the industry only seasonally. It can be said safely that moss gathering is generally considered something to fall back on when other sources of income fail. It attracts as its exclusive ad-

herents only those who for some not necessarily derogatory reason are unfitted for other occupation.

GINNING

The ginner collects the product of the individual gatherer and transports it to his plant. There the moss is first retted, if green or poorly cured. It is then ginned, graded, and baled, and the bales are stored until sold and shipped. The basic equipment necessary to perform these functions includes trucks, retting facilities, one or more gins, a baler, and warehouses or sheds for storage (Figure 7).

The trucks used to transport the gatherer's harvest to the gin are distinctive only in the possession of bodies capable of carrying loose moss. The retting process as practiced at the gin differs only in a greater degree of carefulness from that of the pickers; equipment and procedure are the same.

Although varying in mechanism and design, the ginning machines all function to break up and remove twigs, trash, and other foreign matter from the moss, and to separate the outer covering or cortex from the fiber. They consist essentially of sets of rollers to break up the trash and blowers to separate refuse and fiber. The machines range from homemade makeshifts to factory importations. They vary in the effectiveness of their work, but none was observed that turned out a completely clean product. Steam engines formerly provided the motive power, but today they have been almost entirely succeeded by internal combustion engines and electric motors.

There is variation in the size and weight of the bales of finished moss, determined by the type of baler used and the desire for a loose or tight pack. An ordinary hay baler is sometimes used, producing a bale averaging somewhat less than a hundred pounds in weight, while the product of the regular moss baler weighs around 140 pounds. Balancing the weight of the finished bales against that of the retted moss received from the gatherer shows a loss of approximately fifty per cent. Moisture accounts for a part of the loss, but more largely it is the refuse incidental to the ginning operation.

Great piles of waste material are a characteristic feature of the plant assemblage. Used as fuel in the days of steam power, it is now generally

FIGURE 5. Retting piles and an overturned boat used for moss harvesting in the foreground; in the background moss drying after removal from retting piles.

destroyed to conserve space. Here would seem to be an opportunity to cut the cost of ginning and so increase the narrow margin of profit, for this lone by-product unaltered makes a fair fertilizer and is a satisfactory base for commercial preparations.

The finished bales are placed under cover, where they are sometimes stored for long periods, awaiting market demand or a more favorable price. If kept too long the baled moss molds, which necessitates reginning, a procedure that eliminates any profit for the ginner.

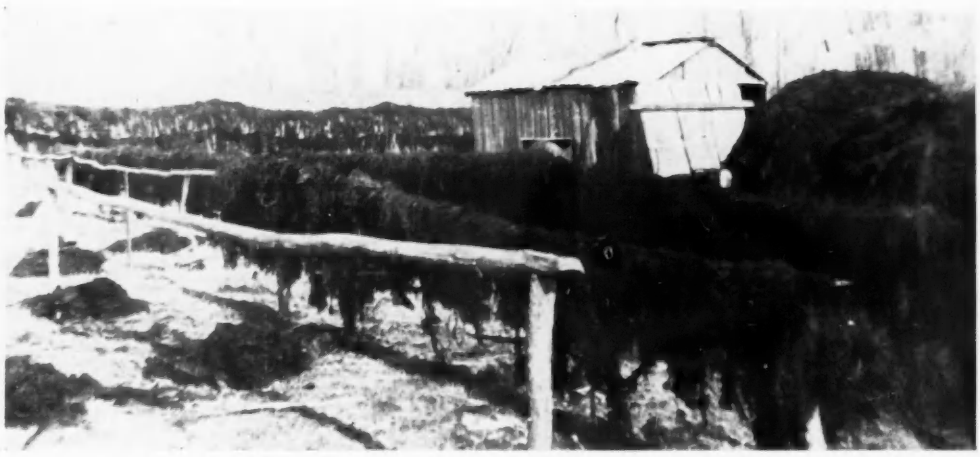

FIGURE 6. Moss drying on pole frames, the final step before sale to the ginner. These frames are about four feet high.

Labor and Capacity: The few data to be found in the sketchily recorded history of the moss industry suggest that gins were formerly more abundant and greater in individual capacity. At present, competency ranges from a daily potential of thirty-five or forty bales for the larger units, down to sixteen or seventeen for the smaller ones. Reports from fifteen gins for 1940 show an annual output ranging from one to fifty carloads, with an average production of approximately twenty carloads (286 140-pound bales).

While the gin foreman is generally a white man, all other labor is predominantly colored, with both men and women employed in numbers proportionate to the magnitude of operation. At one of the larger gins fourteen colored women and a white foreman make up the labor personnel. This particular gin is not in daily operation, but the work is sufficiently regular to provide a rather steady income for the Negro women, while the foreman acts as caretaker of the premises when not superintending the ginning. At another large gin where there is also a white foreman, the daily schedule requires the full-time services of eleven Negro men. One smaller sixteen-bale gin employs seven or eight Negro men and a Negro foreman. Since the larger gins own and operate trucks to collect the moss, additional labor must be employed for that purpose. Small gins sometimes have contracts with truckers who collect and deliver the moss to them.

Marketing: The ginning business is as susceptible to seasonal fluctuations as are most other types of processing manufacture. Operations decrease to a minimum during the period from January to March, gradually increase until

June, and finally reach an annual maximum in November and December. Seasonal fluctuation is a direct response to market demand in connection with the summer and fall manufacture of furniture and the pre-Christmas peak of furniture sales.

The baled moss is sold by the ginners, generally in carload lots, directly to the manufacturer or through the medium of northern brokers or manufacturers' agents operating in the field. Weekly reports keep the agents informed of the supply on hand, while purchases and shipments follow market demand.

The prices paid for ginned moss vary with its quality and with manufacturers' requirements. An average good price for a ten-ton carload is $2,000, which means ten cents a pound. An extreme range is from $750 to $2,200 per carload. The annual range for one large gin in 1941 was from $1,400 in June to $2,200 in November. When the cost of operation and the fifty-per-cent loss in weight are considered, it is clear that the ginners' profits are exceedingly modest. Herein lies one of the reasons for the high mortality rate among moss-ginning concerns.

HISTORY AND PROSPECTS

References to the uses of Spanish moss appear in the earliest accounts of Louisiana. Pre-Columbian Indians employed moss to stuff pillows; it reinforced the mud used to plaster wattle-work huts; it served as swaddling for infants; and it was used to encase patients during sweat-bath treatments. Modern Indians ingeniously spin and weave cured moss into mats; both process and product may be prehistoric.

FIGURE 7. The typical sheet-iron building of the moss gin.

European immigrants were not slow to take advantage of an abundant, free, and highly satisfactory substitute for horsehair. They used it for stuffing pillows, mattresses, and upholstered furniture. Woven into mats, it made excellent saddle blankets. It filled crevices in the walls of crudely-built houses, and it was mixed with clay to make bricks. It was and still is highly esteemed as stock food.

The industry was established as such when specialists took over the gathering and curing of moss and offered it for sale in the city markets. The development reputedly began with the first urban growth, in the middle of the eighteenth century. Gathering and retting processes were little if any different from those of today, but the function served by modern gins, the removal of trash and the separation of husk from inner fiber, had to be accomplished by laborious hand picking.

Successful moss gins seem to have come into use somewhat later than cotton gins, for as late as 1875 both hand picking and machine ginning were practiced. At this date there were only two gins in Louisiana, both operating in New Orleans. Dennett, from whose account these facts are taken, further states that the moss was sorted and ginned and then dyed a deep and glossy black, the more to simulate horsehair. Dyeing was generally practiced up to about twenty years ago, but since that time it has been completely discontinued.

It is evident that in its two-hundred-year existence the Louisiana moss in-

dustry has witnessed a rather gradual but steady evolution of ginning equipment and methods. Gathering and curing, on the other hand, have changed but little. Local use of cured moss in the form of stuffing for pillows and mattresses and the formerly familiar saddle blankets has decreased almost to the vanishing point. In the national field, moss, once extensively used in automobile upholstery, now goes almost entirely to furniture manufacturers.

The whole recorded history of the industry is exceedingly scant, and it is particularly lacking with regard to the matter of quantitative production. Even currently, in the absence of any cooperative organization or legal regulation, there is no agency in possession of precise data. Nevertheless, it is possible to arrive at reasonable estimates of annual production for certain years. The accompanying graphs (Figure 8) show the Louisiana production and market prices for all years where there is any basis for even an intelligent guess. For the great gap between 1875 and 1925, all available information indicates a steady growth in production. Accepting the graph as at least indicative of trends, it is apparent that peak production was reached in the middle 1930's, followed by a sharp and steady decline in subsequent years. Competent opinion supports this general picture.

The recent serious decline in moss production is a response to a rather complex combination of economic and physical factors, some of which have arisen in the market at large while others are local in origin. The competition of other areas and materials, the continued destruction of forests by lumbermen, and a serious though artificial labor shortage have all contributed to the downward trend.

Apparently the industry in Louisiana did not begin to suffer from competition until about twenty years ago, but by 1928 production in Florida equalled in quantity if not in quality that of Louisiana. Furthermore, since the early 1920's the medium-priced furniture field, which provides almost the sole market for moss, has been increasingly invaded by two competitive fibers, crin vegetal and flax upholstery tow.

Crin vegetal is a palm fiber known by the trade as "vegetable hair"; it is imported mainly from the Atlas countries of Africa. Flax upholstery tow is obtained from the straw of flax grown for seed, principally in Minnesota and North Dakota. Both these competitors are definitely inferior to moss, notably in the matter of natural resilience. An artificial resilience is given crin vegetal by twisting the shredded palm fibers into coiled-rope form to impart a permanent

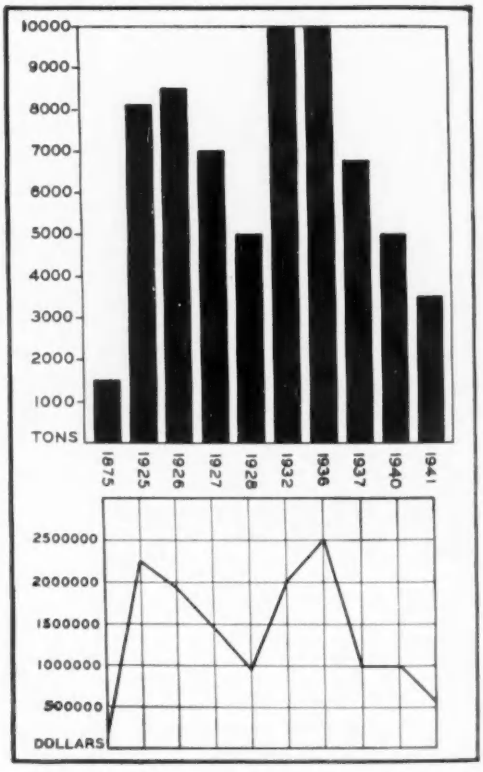

FIGURE 8. The upper graph shows the annual production of finished moss in tons, the lower graph the market value for the same years.

crimp. Flax upholstery tow lacks this desirable characteristic.

Further extracts from the Tariff Commission Report make clear the seriousness of the competition: In 1930 there were imported into the United States 25,715,200 pounds of crin vegetal, while the most reliable estimates place production of flax upholstery tow during the year at about 10,000 tons (20,000,000 pounds). The estimate of moss production for 1930 is below 20,000,000 pounds. For the same year the average market cost to the manufacturer per pound of moss was 8.80 cents, for crin vegetal, 4.13 cents, and for flax upholstery tow, 1.85 cents.

Certain local conditions have tended to aggravate the plight of the moss industry. Logging operations have not only virtually eliminated virgin hardwood forests, but they have invaded even second-growth stands. Whether the progressive removal of accessible sources combined with a poor market was responsible for a decrease in the number of individuals engaged in moss picking is uncertain. It is a fact, however, that during the depression years some gins were unable to obtain an adequate supply of moss, largely because many people previously employed as pickers accepted government relief as their means of livelihood.

It is certain that the period of easy exploitation of moss is over. But, there will probably always be swamp forests in Louisiana, and moss will remain an excellent and reasonably cheap upholstery medium. The future of the industry, therefore, would seem to depend upon its own efforts to effect better methods and organization.

Standardization of procedure and product, a united marketing organization, modern advertising, and perhaps a measure of protection against cheap competitors should assure a healthy permanence to the business. Modernization, however, may tend to remove some of the color and charm from the picturesque aspects of one of Louisiana's oldest industries.

THE MIGRATION AND SETTLEMENT OF DETROIT MEXICANS

Norman D. Humphrey

MEXICANS settled in the United States, especially after 1910, for two major reasons. They felt the pull of the economic advantages to be found north of the Rio Grande, with all their attendant stereotypes of wish-fulfillment, and they sought to flee from the dismal economic future and the political instability for Mexican peasants, which offered very little hope for political safety or economic security. In this connection Bogardus' comment is relevant: "The incentives to Mexicans to immigrate to the United States have been chiefly economic. The higher wages have been effective stimuli: three dollars a day, for instance, in 1929 looked large to a Mexican accustomed to receiving the equivalent of fifty cents . . . ."

The bulk of Mexican emigration to the United States came from the central part of Mexico. Michoacan, Guanajuato, Jalisco, and Zacatecas were the states which furnished more than fifty per cent of the legal entries into the United States, even though they were not the most heavily populated. As a matter of fact, of the three states of the Republic that have more than one million inhabitants, Jalisco is the only one to provide proportionally a high rate of emigration. The "Cristero Revolution" of the 1920's, with its attendant disorders, strongly stimulated Jaliscan emigration. For other sections of Mexico, however, the dynamic factor in the outward flow of population is to be found in the peonage system on the great estates that effectively precluded economic advancement for the vast majority. Peasants thus came to the United States primarily as unskilled laborers drawn from the underprivileged.

As high as sixty per cent of the immigrants in 1926 were laborers, while thereafter fewer were unskilled though the unskilled still constituted about one-third of the total group. Persons having trades included butchers, cooks, bakers, shoemakers, tanners, masons, mechanics, molders, boiler-makers, and miners. But even these individuals who had skills applicable to the Mexican economic milieu, tended to become common laborers in the United States as a consequence of the specialized character of American production. The majority of immigrants were males. A typical migrant was young and in the "prime of life," a situation related to the fact that he usually married after coming to the country, and that a majority of "first children" of Mexican immigrants were born in the United States. On the basis of using the place of birth of the first child as evidence of the point of origin of the family (as distinct from the individual) it may be concluded from the records of 420 families enumerated by the Detroit School Census of 1935 that only 70 had their origin in Mexico, while 350 originated in the United States. In 72 cases, the oldest child was born in Texas, while in 190 cases the first child was born in Detroit. It is clear from these data that most children of Mexican parents were born in the United States, and also that most Mexican couples living in Detroit came to the United States

as individuals outside of marriage, or else came previous to the birth of the first child. Opportunity beckoned to the young and venturesome. Migrants trickled slowly into this country prior to the First World War; and after the stoppage of European immigration, they flowed in a veritable stream. This influx ran its course for a decade. The increment of Mexicans to the American population is illustrated by the facts that in 1920 the Mexican population in Michigan was twenty times greater than in 1910, and in 1930 the 1,422,533 Mexicans in the United States constituted one-twelfth of the Mexican population of the world.

Significant in the stimulation of emigration were the facilitators of illegal entrance, the smugglers or "coyotes," the contractors or "enganchistas" who provided peons with jobs over the border, and perhaps more basically, the farmers and railroads of the American southwest and middle west who required cheap labor for their enterprises. This included labor-recruiting in Mexico and in Texas for beet-field work in the United States. Illustrative of the work of these "enganchistas" and "coyotes" are the following facts drawn from a welfare case record:

> Mr. L. said that the first time he entered the United States (1915) he paid five cents for his bridge toll and that that was the only technicality encountered. The second time he sought entrance, however, (in 1920) an American immigration authority attempted to assess him a head tax of $10.00. He did not have the money, and he turned back, but a "coyote" observed his predicament and put him in touch with an "enganchista" who offered Mr. L. a job. With a job assured, the "coyote" smuggled Mr. L. across the border.

Some indication of the ease with which a person might enter the United States illegally but without the aid of a "coyote" is shown in the following case:

> Mr. R. said that he crossed the bridge at El Paso, Texas in 1924 and when he was asked from what town he came, he answered El Paso, but he did not explain that he came from El Paso, Mexico and not from El Paso, Texas. He was allowed to go through and took the train to Colorado for work in the beet fields there.

Individual reasons and motives for Mexicans to come to the United States are naturally more diverse than the more societal factors enumerated above. A case suggesting such personal factors is the following:

> Mrs. B. was born on a farm in Tecolotlan, Jalisco. When she was a young girl, her three brothers left for the United States. Shortly thereafter her father tried to make her marry a man she did not like, and she tried to marry a man she had chosen. Her father resolved the disagreement by saying to her, "Here is the money. Go to the United States and stay with your brothers for six months. See all the things, have a good time, and then come back." She went and kept house for her brothers. But she married still another man and stayed eighteen years before she went back to Mexico for a visit.

The vast range of other personal motives and rationalizations for emigration includes revolutionary activities that destroyed individual security, promises of high wages and educational opportunities, financial inducements by relatives, sheer boredom, and desires for new experiences and adventures. How these compulsions and others became mixed in individual cases is brought out in the following interview summary:

> The son of an officer in the Mexican army, who lost his position in a revolution, left Mexico at the age of seventeen and came directly to Detroit to become a student at the Ford factory. He had received his appointment through a Ford representative in Mexico. He worked at Ford's for eight years and then returned for an eight-month visit to Mexico. He then came back to the United States, first to Houston and then to Ford's in Detroit.

The work of the "enganchistas" and of newspaper stories describing the Ford Motor Company's labor policies have been so effective that many Mexicans come to the United States with the sole object of working at Ford's, seldom realizing beforehand that other large industrial plants make similar inducements. Most Mexicans, however, come

to the United States with expectations for agricultural or railroad track work.

From a national viewpoint Texas has been the main settling point of entering Mexicans and in Texas itself, San Antonio is the largest Mexican center. From Texas a secondary migration has occurred to all parts of the United States. The other border states also became points of heavy settlement by Mexicans entering this country for the first time. The Mexican immigrants who finally landed in Detroit reached this destination after drifting through intermediate stops in Texas or other western states.

The Mexican colony in Detroit first grew to noticeable size in 1918, when several hundred Mexicans came to the city to work in the motor-car factories as students. Later, laborers poured in to replace workmen who had enlisted to fight in the American army. The members of the colony at this time were noted to be "unobtrusive, industrious and patriotic." In December, 1920, the colony was estimated to have eight thousand members, but two months later the colony is reported to have dwindled to two thousand five hundred persons. "Most of those who left Detroit had worked in the sugar beet fields in the summer and came to Detroit for the winter at the promise of jobs," which then did not materialize. Such was a journalist's explanation of the startling drop in the population of the colony. The Mexican government helped the exodus by paying return fares to Mexico.

With better times the colony began to increase on a firmer basis. In 1923, Our Lady of Guadelupe Church was opened indicating the formation of an institutional skeleton for a permanent Mexican body. In 1926 there were an estimated 5,000 Mexicans in Detroit and 1,500 others in Michigan. The colony reached its maximum in 1928, when unsettled conditions in Mexico caused thousands to migrate to the United States. It is estimated that the colony at that time numbered fifteen thousand.

With the onset of the depression of the '30's the number declined. At first the Mexican consul, Ignacio Batiza, attempted to institute a relief program in Detroit for his charges; but eventually a repatriation program began to take form. On October 10, 1931, sixty-nine Mexicans left Detroit, and it was significantly the Detroit Department of Public Welfare in coöperation with the Mexican government that made their return possible.

Regarding the group which left, Batiza said: "The Mexican colony of Detroit is young. The majority of the 15,000 Mexicans have not been in the United States more than five years. They have not yet adapted themselves to the American ways and have been hit hard by the current depression." He estimated that five-sixths of the 50,000 Mexicans had gone from the area by the end of 1932, "more than half of whom returned to Mexico." Actually, by the end of 1932, 1,500 Mexicans had been sent from Michigan, and lesser numbers went back from other near-by states. Most of these removals were made as voluntary repatriations.

The motives for returning to Mexico were primarily economic. Unable to find employment in Detroit, the breadwinner who was willing to return felt certain that he would obtain agricultural work in Mexico. The Mexican government offered to supply repatriates with land and with the tools to work it. Such were the main incentives operating on the Mexican to return to the homeland. In addition to this force pulling the immigrant, there was a strong force pushing him out which

took one form in hostility manifested toward him by relief workers.

The exact Mexican population of Detroit at any one time is difficult to ascertain. The most accurate figure is that of the Federal Census which in 1930 enumerated 6,515 Mexicans in Detroit. The official estimate of the Detroit Board of Education Statistical Bureau for 1934 (the estimate including all Mexican children whether born in the United States or in Mexico) stated that 278 families were enumerated and that the total population was 1,946 persons. In the same year Consul Batiza placed their number at 4,000

TABLE I

NUMBER OF MEXICANS IN DETROIT—1934

EXCLUDING SINGLE PERSONS

(1) Total number of families	278
(2) Total number of children	879
(3) Total number of male adults	883
(4) Total number of female adults	184
(5) Total number of (2), (3), and (4)	1,946
(6) Average number of children per family	2.2
(7) Average number of persons per family	7.0

In the 1935 School Census of Detroit 456 families were enumerated, containing in all, 2,220 persons. The same figure was given for the Mexican population in 1936 by A. H. Navarro, then consul.

TABLE II

NUMBER OF MEXICANS IN DETROIT—1935

EXCLUDING SINGLE PERSONS

(1) Total number of families	456
(2) Total number of children	1,612
(3) Total number of male adults	450
(4) Total number of female adults	162
(5) Total number of (2), (3), and (4)	2,224
(6) Average number of children per family	3.4
(7) Number of families with children	448
(8) Average number of persons per family	5.5

The changes in population obviously are reflections of changing economic opportunities during this period, better times attracting migrants. On the other hand, Detroit Mexicans have not been as mobile as have the notoriously mobile Mexican farm laborers in the western United States. The 1935 School Census of the 456 enumerated Mexican families in Detroit showed that 76 per cent of the children born of Mexicans in Detroit were from families which came into Detroit in 1930 or before. Using the place of birth of children as the criterion of geographic mobility or immobility, we may conclude that the families in Detroit in 1930 who were not repatriated tended to remain here for at least five years subsequent to that date. While this statement takes no account of single individuals, the fact that only eight of the 456 families did not have children, indicates that there was little childlessness among married couples, which would become a factor promoting permanence. Within Detroit, however, mobility is great, with constant movement from less desirable to more desirable homes within a neighborhood.

With the defense boom of the 1940's a new influx of Mexican labor occurred. By 1943 some 4,000 to 6,000 Mexican immigrants and their children had been crowded in the interstices of stores and factories on the west side of Detroit's central business district. And one can predict, on the basis of two previous instances, that during the forthcoming post-war depression another mass exodus to the southern homeland will be developed.

THE GEOGRAPHY OF CRAB ORCHARD: A SUBMARGINAL AREA IN SOUTHERN ILLINOIS

*John L. Page and Eugene Mather**

THE Crab Orchard Basin is a submarginal area on which a large experiment in land utilization and industrial development is being undertaken by the Federal Government. This project, having an area of approximately 31,000 acres, is situated on the north flank of the "Illinois Ozarks" in Williamson and Union Counties, most of it within the former county (Figures 1 and 2).

The purpose of this study is to present a geographic survey of the project at the time of its acquisition by the Federal Government. Such a survey might be used for comparative purposes in the event of planned development of similar submarginal areas in Kentucky, Tennessee, and the Ozark region.

The Physical Setting

Climate

The climate (Figure 3), which is Cfa according to the Köppen classification, has great temperature extremes, especially in winter. The growing season lasts on an average 192 days. It varies, however, from place to place within the area because of air drainage. Carbondale, the nearest weather station, has an average annual precipitation of 41.89 inches. Fortunately, the precipitation is greater during the summer half year and thus coincides with the period of greatest vegetative cover and delayed runoff. December, the driest month, has an average of 2.84 inches; June, the wettest month, has an average of 4.48 inches.

Significant in connection with the soil erosion problem in this area is the unreliability of precipitation (Table I). Occasionally severe droughts occur, while at other times excessive precipitation falls within a brief period. Illustrative of unreliability is the 5.41 inches rain which fell in 1935 from June 10 to 20, inclusive. This exceeded the total precipitation during the period December 1, 1935 and June 1, 1936, inclusive.

TABLE I

Periods of Insufficient Precipitation

Year	*No. of Successive Days with Total Precipitation Less than 1 Inch*	*No. of Successive Days with Total Precipitation Less than .01 Inch*
1931	34	19
1932	31	14
1933	47	23
1934	47	15
1935	26	17
1936	46	22
1937	38	16
1938	46	30
1939	62	25
1940	63	15

Physiography

The project may be divided into two physiographic sections: the young till plains in the north and the low maturely dissected former plateau in the south.

The till plains section is underlain by the Carbondale group of the Pennsylvanian system. This formation is

*The writers wish to acknowledge the help given them by J. B. Venable, Carterville, Illinois, who has been a resident of the Crab Orchard area for many years, and to Geo. Zahorchak, Washington, D. C., who drew both maps used in this article.

FIGURE 1.—General location of Crab Orchard Project.

composed of gray shales, brown and generally micaceous sandstones, thin impure limestones, and from one to six coal beds. The Murphysboro (Number 2) coal bed is situated at the base and Herrin (Number 6) at the top of the group. However, glacial drift (Illinoian), loess, and alluvial deposits in the valleys have largely obscured the configuration of the bed rock surface. Although the thickness of the drift varies considerably, it has greatly modified the irregularities of the topography and imparted to it a more rounded aspect with gentler relief. The Illinoian glacial sheet had an irregular front with its most southerly advance in the valleys of the northward flowing tributaries of Crab Orchard Creek. Alluvium, predominantly fine silt and sand, has been deposited principally along Crab Orchard Creek and the lower Big Grassy and Little Grassy Creek valleys.

The dissected former plateau section is a part of the "Illinois Ozarks," an eastward-extending spur of the Ozark Plateau of Missouri. This dissected section is underlain by the Caseyville and Tradewater groups of the Pennsylvanian system. The Battery Rock and Pounds formations of the Caseyville group outcrop, as does the Grindstaff formation of the Tradewater group. This area is maturely dissected and unglaciated, and its local relief is approximately twice that of the till plains. Stream valleys are well defined and only local areas are covered by alluvium. Upper portions of the valleys are frequently headed by a series of gullies, and cliffs have developed along some of the ravines. Weathering has been noticeably affected by faulting and jointing. Sheet erosion, while less spectacular, has probably resulted in much greater losses than has gullying.

Both the till plains and the dissected plateau have a non-stratified, calcareous loessial cover. In some areas the loess is fifteen to thirty feet thick, but erosion has removed much of it in the more exposed places, especially in the upper valleys. Elevations above sea-level within the project area range from approximately 375 to 750 feet. Thus the maximum relief is about 375 feet.

Drainage

Crab Orchard Creek, the largest stream in the vicinity, drains approximately 200 square miles of Williamson County including all of the Crab Orchard project. Its waters empty into the Big Muddy River, a tributary of the Mississippi. Big Grassy and Little Grassy Creeks, the principal tributaries of Crab Orchard Creek, have a stream flow which fluctuates greatly. This is especially characteristic in early spring when the vegetative cover is relatively meager; not infrequently the runoff is excessive, causing widespread flooding in the lower valley areas.

Soils

The soils represented are woodland types, are generally impervious and have a low organic content. They are generally deficient in nitrogen, potassium, and phosphorus. The most pro-

ductive of these soils, all of which are loams, has a rating of 6 (the Illinois State Soil Survey rates the state's most productive soils at 1, and the least productive at 10). However, soils with ratings of 8, 9, or 10 cover most of the project. Thus, the variety of crops that could be grown is definitely limited. As runoff is rapid, there has been a serious soil erosion problem, and since the moisture-retentive capacity is low, crops were more drastically affected during drought periods. Table II is an estimate of soil erosion made by the Department of Agronomy, University of Illinois.

TABLE II

ESTIMATE OF SOIL EROSION

Degree of Erosion	*Williamson County*	*State of Illinois*
Destructive	16.7 per cent	8.7 per cent
Serious	43.2 per cent	8.8 per cent
Harmful	22.3 per cent	35.4 per cent
Negligible	17.8 per cent	47.1 per cent

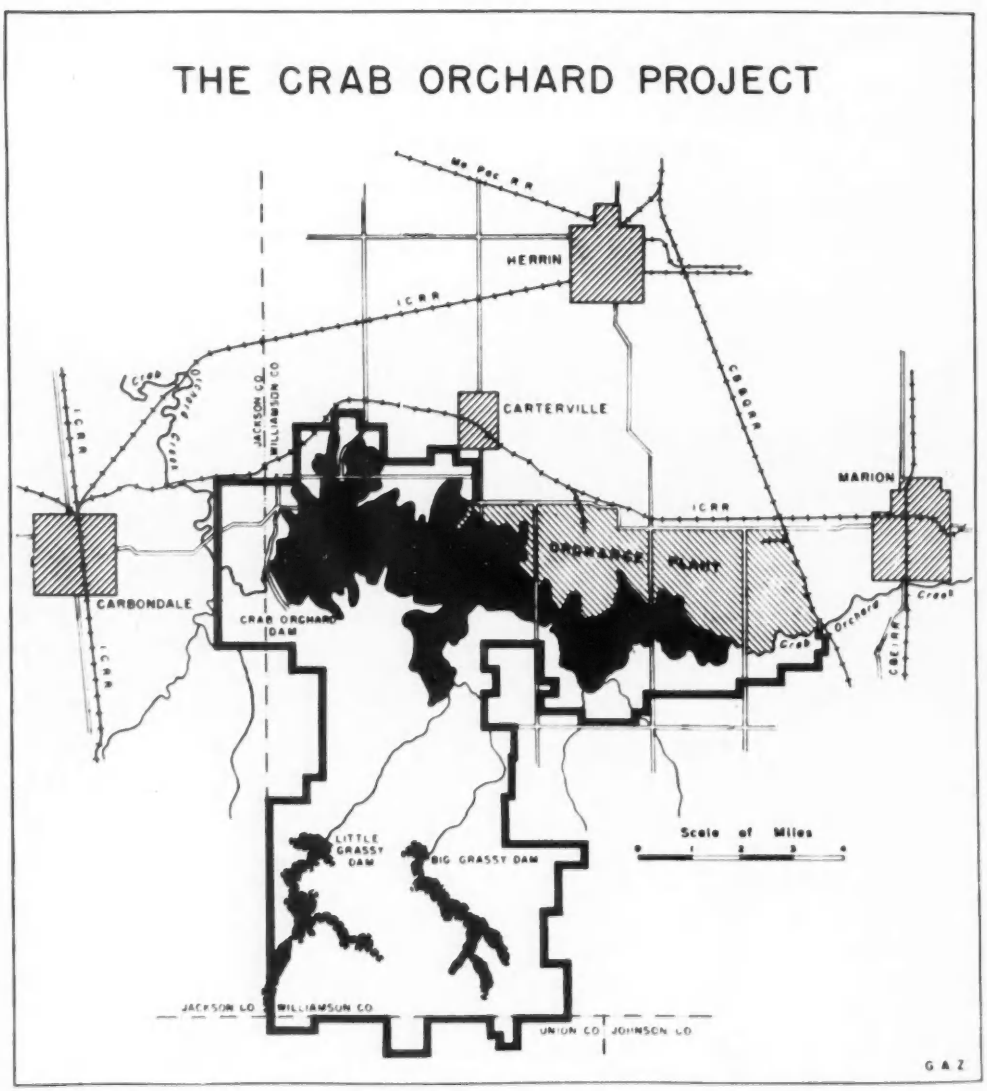

FIGURE 2.—Crab Orchard Project and its relation to surrounding cities.

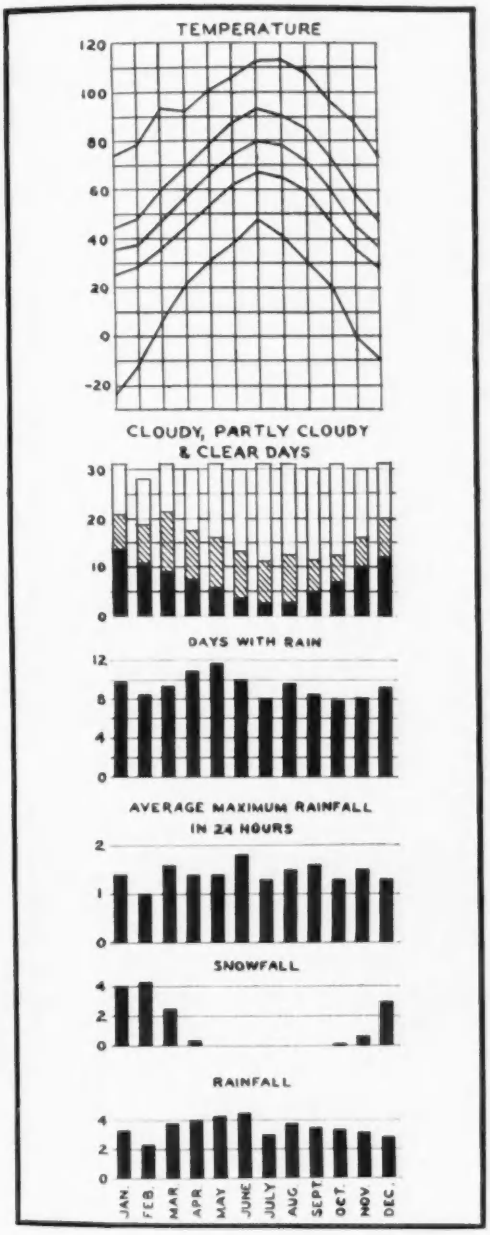

FIGURE 3

Temperature: The temperature curves from top to bottom represent the absolute maximum, the average maximum, the average, the average minimum, and the absolute minimum temperatures for the period 1890–1940 inclusive.

Cloudy, Partly Cloudy, and Clear Days: The number of cloudy days is represented by solid bars, the number of partly cloudy days by cross-hatching, and the number of clear days by outline bars. The record represented is from 1931–1940 inclusive.

Maximum Precipitation in 24 Hours: Period represented, 1931–1940 inclusive.

Snowfall: Represents a 31-year record up to and inclusive of 1940.

Rainfall: Represents a 46-year record up to and inclusive of 1940.

Units of Measurement: All the temperature readings are on the Fahrenheit scale; all snowfall and rainfall is in inches.

Location of Weather Station: Carbondale, situated three miles west of the Crab Orchard Creek Dam.

Water Supply

The water supply has been unreliable and during drought periods is insufficient to meet the normal demands of mines, municipalities, and farms.

Farmers formerly obtained their water from wells and from small artificial surface reservoirs. Usually these surface reservoirs were situated in permanent pastures near the barns and served to supplement livestock requirements.

Municipalities constructed larger surface reservoirs. Sub-surface sources were relatively unimportant since the glacial drift is thin and the drilling of deep wells is costly. Moreover, the well water, because it is often highly charged with minerals, is undesirable for many urban uses. In spite of the compact nature of the soil, municipal surface reservoirs have been inadequate. These reservoirs became dangerously low during prolonged periods of insufficient precipitation. In the autumn of 1941, for example, Carbondale's supply was nearly exhausted and additional water was obtained through a pipeline laid to Crab Orchard Lake. According to present plans, the pipeline which is equipped with a pumping station, will be used during future drought periods.

Coal mine operators have resorted to various emergency methods during droughts to obtain water needed for the operation of steam engines. Such emergency methods as the use of rail-

way tank cars have been costly and inefficient, and thus are not satisfactory solutions to the water supply problem.

Natural Vegetation and Animal Life

Among the chief resources of Crab Orchard are the forests and the relatively abundant animal life. They were an integral part of the pioneer economy, and they are playing an important role in the present recreational development.

Oaks, mostly white, burr, chestnut, red and black, dominate the upland forest flora. Gum, sassafras, and ash trees are also common. On the cliffs along the ravines, where heat, light, and moisture are prime factors governing the vegetation, ironwood, red cedar, ferns, and flowering plants may be found. Most of the larger tree specimens in the floodplain association have been cut for lumber; only a few virgin stands remain. Heavy undergrowth, sometimes so thick as to constitute tangled thickets, is found in the less-thickly shaded areas that are not subject to periodic inundation. In 1939, W. H. Schumke in his "Wild Life Survey and Recommendation Report for the Crab Orchard Creek Project" recorded fifty-seven species of trees within the project area.

When viewed in relation to the entire state of Illinois, Crab Orchard is quite conspicuous as a habitat for wild game. Each year many sportsmen come to the area and report finding muskrat, otter, mink, raccoon, weasel, squirrel, chipmunk, rabbit, oppossum, coyote, and red and gray fox. Fish found in this area include bass, sunfish, crappie, bullheads, suckers, minnows, and horned dace. Furthermore, Crab Orchard is near the Mississippi which is the flyway for Canadian geese as well as for numerous species of duck.

Mineral Resources

The mineral resources of the region are very limited and are in great contrast to the rich coal, limestone, petroleum, and kaolin resources proximate to the area. The Pounds sandstone, which outcrops in the dissected section, could be used for construction purposes. However, the outcrops of this sandstone beyond the limits of the project are more favorably located for economic exploitation. The gravel deposits are composed largely of sandstone and are undesirable for construction purposes. The small deposits of glacial sands are not utilized commercially. Recently, a drilling attempt for oil just beyond the southeast boundary of the project tapped a "gas pocket." There are, however, no oil wells within the project, and the extensively-mined coal beds of the Carbondale group lie immediately to the north.

THE PEOPLE AND THE LAND UTILIZATION RECORD

Many settlers began migrating about a century ago, especially from the mining and mountainous sections of Kentucky and Tennessee, into the "Illinois Ozark" region. The region was attractive then as river transportation was important and the "Illinois Ozarks" were well situated near the confluence of the Ohio and Mississippi Rivers. Furthermore, the region had a productive topsoil as well as a fine stand of forests which were needed for construction purposes.

In view of the prevailing economic philosophy of the period it is not surprising that lumbering became one of the most important early occupations. Sawmills were scattered throughout the area and culled out the more desirable and accessible trees. Lumbering had passed its hey-day by 1900 and was

definitely on the decline. As in many sections of the United States, men robbed the land of its finest trees, then migrated to other virgin forests to repeat the process.

Agriculturists worked simultaneously with lumbermen in the process of denuding the land of its forest. To the cultivator the words "woodland" and "wasteland" were nearly synonymous. Small plots of land were cleared and the soil was turned by the plow. Wheat, the major crop, furnished most of the cash income. The immediately profitable results of wheat production induced more people to settle in the Crab Orchard area. The spread of agriculture was accelerated by the extension of the Illinois Central Railroad into the Big Muddy Basin and by the improvement of the other transportation facilities. By 1900, however, it was evident that the practice of growing wheat as a major crop was being abandoned.

Three hundred and eighteen families, or approximately twenty-six persons per square mile, resided on the Crab Orchard project when the government commenced its rehabilitation program in 1935. The maximum population was attained a few years prior to 1935; during the period 1930 to 1935 there was a slight decrease. All of the population was white and strictly rural, although approximately one-half of them should not be classified as farming population since the major portion of their income was derived from working in the coal mines or from being on federal and county relief roles. Nearly all of these people were, however, engaged to some extent in agriculture.

The farm buildings were generally constructed of native timber and were kept in good condition until the post World War I depression. At this time many of them fell into a state of disrepair. Most of the farmsteads were situated along unsurfaced dirt roads which were, except in the more rugged parts of the dissected former plateau section, laid out on survey lines. In the dissected section the road pattern was somewhat irregular since some of the roads were laid out along the higher, better-drained portions of the major interfluves, irrespective of survey lines.

At the time of the government purchase, 41 per cent of the land was in pasture or range, 31.2 per cent was cultivated, 26.3 per cent was woodland, and 1.5 per cent was orchard land. Most of the farms had a small capital investment and provided a low income. The produce that was consumed directly by the operator's family constituted a large proportion of the farm income. Farms that were rented were usually handled on a share basis. Farm ownership by the operator was relatively high, which may be attributed in large measure to the small size of farms and the small per-acre investment in the land.

Corn, wheat, and forage crops occupied most of the cultivated land. The yields were low; only a small portion of the farm income being realized through crop sales. Some farmers engaged in commercial orcharding, but the total amount of orchard land was relatively small. Usually the poorest land was left in pasture or woodland. The pasture provided the principal source for sustenance for livestock during all but the winter season when lespedeza, timothy, cowpeas, and some soybeans were used as forage. The predominantly acid soils, except for a few instances where artificial fertilizer was applied, precluded the growing of alfalfa.

The small amount of feed produced per farm restricted the livestock carrying capacity, so that most farms kept only three or four cows, a few hogs, one or two teams of draft horses, and a few

TABLE III

Unit	*Average Acreage Per Farm*	*Crop Land Harvested Per Farm*
Carterville Township	71	41
Grassy Township	101	35
Illinois	137	81

Unit	*VALUE OF FARM LAND AND BUILDINGS*		*Per Cent of Land Rented by Acreage*
	Average Per Farm	*Average Per Acre*	
Carterville Township	$1,523	$21	29.98
Grassy Township	1,195	12	26.50
Illinois	9,536	70	58.83

chickens. Many farms had only three to six brood sows. Cream and eggs produced beyond the operator's own requirements were usually sold in the near-by market town and were important as a source of cash income.

The most important type of agricultural unit was the *full-time general farm* which required the full-time services of the operator and was the family's sole source of income. A second type of agricultural unit was the *part-time general farm* which supplemented the operator's mining wage with shelter, fruit, vegetables, milk, eggs, and meat. When the mines closed during the last great economic depression the family derived all of its income from the farm unless it was forced on a relief roll. A third type of unit was the *general farm with a commercial orchard and/or garden.* While only 1.5 per cent of the total land was in orchard, the capital and labor involved and the financial returns were proportionally much greater per acre than on the non-orchard land. Most important among the specialized farm crops were apples, peaches, tomatoes, and strawberries. The expansion of orcharding and gardening, however, was restricted by the large capital investment required, the damaging frosts during the blossoming period and the unreliable precipitation. Table III reveals some of the agricultural contrasts between the dissected section and the till plains section. The agricultural statistics are for the year 1935. Those for Grassy Township are a close approximation for the southern dissected section while the data for Carterville Township are representative of the northern glaciated section. It will be noted from this table that the average farm in the northern part of Crab Orchard was smaller, had a greater per acre as well as per farm value, and had more crop land per farm than did the southern part of the project. In contrast to the state, the project area had less acreage per farm, less crop land harvested per farm, a lower value of farm land and buildings, and also a smaller percentage of rented land.

RELATED ECONOMIC FACTORS

Events which occurred between World War I and World War II indicated clearly the complex character of the economy of Crab Orchard. In fact the economic status of all of "Little Egypt" was determined in a large measure by factors governing both coal mining and agriculture. The depressed economic status in the Big Muddy Basin was first clearly evidenced in 1922 as the result of a new wage adjustment, "The Jack-

sonville Agreement," which allowed non-unionized fields to capture some of the coal market of the unionized fields. Moreover, the coal mines of southern Illinois suffered from a differential freight rate which enabled the Virginia and Kentucky fields to market coal in Chicago at a lower price than the Illinois fields. With decreased coal production came declining payrolls, a shrinking buying power, and a dwindling farm market. The combined payrolls of coal mines, railroads, and public utilities in Williamson County, for example, dropped from $16,333,860 in 1923 to $2,977,576 in 1932. Persons engaged in transportation, in the machine shops, and in local merchandising suffered correspondingly. By 1934, according to the Illinois Emergency Relief Commission's Biennial Report, 48.4 per cent of Williamson County's population were on relief.

THE PRESENT DEVELOPMENT

The Crab Orchard Project was organized in February 1935 when the government began purchasing the land. The entire population was moved and aid in relocation was given by the Resettlement Administration. Reasons substantiating the land purchase have been summarized in a project report as follows:

1. "This land is largely submarginal, and is classified by the State Land Use Planning Board as an area in which the farms are too small."

2. "The bottom lands involved in the purchase area are very poorly drained, subject to overflow almost annually, with the result that three crops out of five are all that can be counted upon. The slopes are subject to serious sheet and gully erosion, and the ridge tops are badly damaged by drought nearly every year because they do not carry sufficient humus to resist long periods of dry weather."

3. "A great deal of the acreage is owned by part-time operators who find outside employment when it is available. This condition results in serious neglect of the land, which further contributes to its unproductiveness."

4. "Many of the tracts are too small to be economic operating units, with the result that economic pressure forces utilization of this land for purposes for which it is not best suited."

5. "Evidences of rural poverty are prominent on many of the tracts, and it has already been demonstrated in the case of owners who have already been paid for their land in this project that they can move to other sections of the State and secure more productive and all-around desirable farms for the amount of money they receive in the sale of these properties."

The plans of the Crab Orchard Project provide that measures be taken for: (1) wildlife development, (2) recreational development, (3) reforestation, and (4) water conservation and flood control. Some phases of the development program have already been accomplished. When the program is completed the project area will have three lakes, formed by the damming of Crab Orchard, Big Grassy, and Little Grassy Creeks (Figure 1). In addition there will be improved controlled grazing land, reforestation of some sections, and numerous improvements associated with recreational development which will provide facilities for fishing, boat-

FIGURE 4.—Ordnance Plant, Crab Orchard, Illinois. View from a highway between Carterville and Marion, Illinois.

FIGURE 5.—Scene of the Ordnance Plant grounds at Crab Orchard. View from highway between Carterville and Marion, Illinois.

ing, swimming, hiking, hunting, and wildlife study. However, the plans formulated in 1935 did not anticipate our early involvement in a war. Fortunately, the project was quickly converted to help meet war demands through the construction of a tremendous ordnance plant on the north shore or Crab Orchard Lake (Figures 2, 4, and 5). Before World War II, advocates for industrialization in southern Illinois had pointed out some of the advantages of this region including the low cost of living for workers, the well-developed transportation system, the cheap land for plant location and future expansion, the proximity to the population center of the United States, and the location which from a military viewpoint is one of the nation's most invulnerable. Moreover, southern Illinois has considerable oil reserves and enormous bituminous coal reserves. The latter are near the surface and can be easily mined. According to some estimates, the coal reserves are larger than those of Great Britain. While there are no large cities in southern Illinois, the population is fairly dense, there being approximately 200,000 people within a 25-mile radius of Herrin (Figure 1). The transportation facilities include three railway lines (the Illinois Central, the Missouri Pacific, and the Chicago, Burlington and Quincy) which converge at Herrin, in addition to an extensive network of paved highways. By the time of our entry into the war the Crab Orchard Dam had been completed and the storage basin was filled. This stone-faced, earthen dam is 2,960 feet long and has a maximum height of 35 feet. The reservoir covers nearly 7,000 acres and has a storage capacity of 24 billion gallons. It is called Crab Orchard Lake. The impounded water alleviates the section's one great handicap to industrial development, namely, an unreliable water supply. The project's water supply will be augmented further when the dams on Big Grassy and Little Grassy Creeks are completed. They will have a water storage capacity of 9 billion and 8 billion gallons, respectively.

SUMMARY AND CONCLUSION

A marked evolution of the geographic landscape of Crab Orchard has been evidenced. What was once a rich area attractive to pioneer settlement became one of the nation's acute problem areas. The problems encountered, however, are being met by a prudent, comprehensive land-utilization program under the con-

trol of the National Government. Remarkable assets for industrial development have been noted and the greatest deterrent to industrial development, an unreliable water supply, already has been solved. War industry is situated on the shore of Crab Orchard Lake. Perhaps the nature of this industry will adjust itself after the present war and become a factor in the development of a more stable peacetime economy for this region.

CURRENT ASPECTS OF AMERICAN AGRICULTURE

W. I. Myers

OUR government has planned generously for the armed forces and for munitions, ships and planes but, because of the erroneous belief that we had great surpluses of food, it has taken an abundant food supply for granted. Its actions have apparently been based on the assumption that production of all foods could be expanded to meet any needs that might arise without careful consideration and planning for agriculture such as were given to other vital parts of the nation's war economy.

In recent months a number of constructive steps have been taken to remove some of the handicaps to full production of food. A man of nationally recognized ability and experience was appointed as War Food Administrator. However, since he was given responsibility without adequate authority, resignation was the inevitable result.

Another man of proven ability and broad experience in agricultural affairs is now serving as War Food Administrator. Although the present incumbent has been made a member of the WPB and OWM, he, too, is handicapped by lack of authority in much the same way as his predecessor. Under the present administrative setup the principal function of the War Food Administrator seems to be to accept public responsibility for decisions on food policy and operation made by the Director of Economic Stabilization and the Director of War Mobilization. No realistic program of food management and utilization has yet been presented to the American people. We are continuing to extemporize our food program from week to week in blind disregard of the dangers involved in such action.

For more than twenty-five years prior to the present war, United States food production did not keep pace with population. In the five-year period 1935–39 just before the present war, our per capita production of all food was 6 per cent lower than during the corresponding period just prior to World War I.

This downward trend in food production was obscured by declining food exports and by the long depression of the thirties. During that decade, per capita food production in the United States was lower than in any other period in the present century. In no single year during the thirties did per capita food production get up to the 1926–30 level. The public was told we had enormous food surpluses but the real trouble was inability of consumers to buy rather than overproduction. We were struggling with a price problem, not a surplus food problem. When employment increased, consumption rose and the so-called food surpluses disappeared quickly.

The people of the United States constitute the world's best market. In ordinary times we eat what food we want and then export the remainder, if any. Hence, as per capita food production declined, food exports decreased, food imports rose and for 16 years prior to the present war our annual food imports exceeded our food exports.

Another factor contributing to the present food problem is that the steps

taken by the Government to increase production were added to agricultural programs established during the thirties and designed to restrict production in a period of low prices and widespread unemployment. As a natural result, acreage restrictions were continued even after the need for full production became clear. Although modified, in 1943 these restrictive programs still limited directly or indirectly, the acreage of the best adapted crops that could be grown in many regions, thus preventing farmers from freely organizing their resources for maximum production of food. At long last, it has been announced that all acreage controls on food and feed crops will be eliminated in the 1944 food production program.

Aided by favorable weather, farm families have turned in a magnificent performance in food production in spite of much unfair criticism and innumerable handicaps, regulations and annoyances. They have increased the length of their already long working day to the physical limit. However, agriculture is a biological industry. Food production is determined by the life processes of plants and animals which cannot be hastened. A delay of a month in a plane or a tank program means a month lost. A delay of a month in a food program may mean a year lost. Total food production cannot be increased quickly except by the chance of favorable weather; nor can violent shifts be made promptly in the production of different crops and animals required to meet war needs.

PRICES AND FOOD PRODUCTION

The food problem of the United States is to an important extent a problem of prices. There are many important considerations in the farm price question in wartime. The question to which most public attention has been given is "What prices will give reasonable equity between the incomes of farm people and of other groups?" The most important question in wartime, however, is "What prices are necessary to get the essential foods produced?"

The principal cause of public misunderstanding of the farm price situation is the failure to realize that the 1935–39 pre-war period is an unsound base from which to compute relative wartime increases in farm prices and in factory wages. During the thirties city consumers became accustomed to food prices that were too low to be maintained in any period of active business which would provide alternative jobs for farmers and farm workers. In spite of considerable unemployment, the hourly earnings of employed factory workers for the period 1935–1939 were the highest in history up to that time and 14 per cent above the level of 1929. In striking contrast, United States farm prices were still at depression levels and 27 per cent below 1929. This disparity between farm prices and factory wages was further widened by wage increases, longer work-weeks with overtime pay, and other measures which increased the pay checks of factory workers during the early years of the war.

Congressional insistence on the use of the "parity" formula in fixing ceiling prices of farm products was an attempt to prevent the general freezing of farm prices at levels that would restrict food production. While "parity" was a useful guide to the general level of farm prices necessary to maintain production, it cannot safely be used in the establishment of fixed ceiling prices for individual products, since it is based on historical relationships many of which have changed. The use of parity for the establishment of ceiling prices for individual farm products is responsible

for many of the maladjustments between these prices at the present time.

During World War I, the per capita net income of the United States farm population increased more rapidly than that of the non-farm population. Following 1920 the incomes of farm people declined and remained unfavorable in all except three years of the 20-year period from 1921 to 1940. In 1942 and 1943 the per capita net incomes of the farm population have again attained a favorable relation with non-farm, as compared with 1910–14, although the estimated per capita net incomes in 1943 are $496 for the farm and $1216 for the non-farm population.

Although in August 1943 retail prices of food were 37 per cent above the low levels of 1935–39, they have increased less than the average per capita income of all the people in the United States. At present retail prices, the cost of a standard food budget takes 16 per cent of the average per capita income, the lowest figure in the last thirty years for which data are available and substantially lower than the range of 24 to 31 per cent during World War I. Actual expenditures for food at July 1943 retail prices amounted to 20 per cent of average per capita incomes, this higher figure being due to the larger proportion of choice foods being purchased by war workers at the present time.

With average yields the present level of farm prices will result in farm incomes which, while well below the earnings of industrial war workers, are favorable in comparison with farm incomes during the past twenty years. From the standpoint of long-time farm welfare any further marked increase in the general level of United States farm prices not necessary to meet higher farm costs is undesirable because it would increase the danger of inflation of farm land values. Furthermore, the families who remain on farms will do their utmost in food production at any level of prices. The vital question is not the level of farm prices that farmers want; it is the level that should be established in the real interest of the nation in order to permit farmers to retain labor against industrial competition, to meet increasing costs, and to maintain maximum production permitted by weather.

What Prices Are Necessary to Get the Essential Foods Produced?

The first requirement of a wartime food program is to insure the production of the kinds and quantities of foods necessary to meet probable needs. The only effective way to shift agricultural production is to adjust prices of the foods concerned to bring about the changes desired.

In spite of this, our food price policy has been consistently subordinated to the general program of rigid price ceilings to keep down the cost of living and control inflation, ignoring the effect of many of these prices in restricting production of needed foods. Little consideration has been given to the necessity for higher prices to cover the higher unit costs of short crops. Rollbacks have been ordered in the prices of meat, butter, eggs and other scarce foods to reduce the cost of living to some arbitrary level without regard to their effect in reducing production and increasing the shortage.

In addition to restricting production, our food price policy has increased the difficulties of making wise use of our food resources. With many more workers employed, higher wage rates and longer hours of work, total factory payrolls are more than three times the average of the pre-war period, 1935–39. Since supplies of other consumer goods and services have decreased because of war, this increased buying power has caused

a sharp rise in the civilian demand for meat and other choice foods. In 1942, civilians ate substantially less than in 1935–39 of the cheaper foods such as potatoes and dry beans, and considerably more of the highly-prized foods such as meat, poultry, eggs, milk, and cream.

In time of peace such a change in diet would be highly desirable but in wartime it increases the pressure on a limited agricultural output because of the relatively large amount of land and labor required for the production of these concentrated foods. In this situation, efforts to prevent inflation primarily by the use of rigid price controls have tended to decrease production of many scarce foods, to increase their consumption, and to induce evasion or black markets.

The greatest danger in the present food price policy is the inflexibility of ceiling prices of individual food products. Serious maladjustments in the price structure have been frozen there by inept and inflexible administration. Under ordinary conditions farm prices of food fluctuate constantly to bring about adjustment between demand and supply. Frozen prices prevent this corrective action and result in steadily increasing maladjustments the longer they are maintained.

The most unfortunate example of these price policies is the present corn-hog price situation. Corn is the greatest agricultural raw material of American farms. It constitutes about 60 per cent of all grain concentrates used by all forms of livestock and at the same time is an essential industrial raw material.

For many months the price of hogs has made corn worth about $1.40 or more a bushel as feed for hogs. At the same time, there has been a ceiling price on corn sold in the open market at $1.07 per bushel at Chicago. The result has been a phenomenal rise in hog numbers and increasing difficulty for corn millers, dairymen, and poultrymen in getting corn for their needs. Naturally, they cannot get corn at the ceiling price because the government guarantees the Corn-belt farmer a higher return by feeding his corn to hogs and selling the hogs.

Although the index numbers of corn prices have been held down, the cost of feed to northeastern farmers has not. Largely as a result of having to substitute oats and barley at about $55 a ton for corn at $41 a ton, but not available, prices of dairy and poultry rations have risen about 30 per cent during the past year.

In ordinary times corn-hog price relationship changes frequently in accordance with changing conditions of demand and supply. Present government price policies have already jeopardized the supply of fresh milk and eggs for cities, foods which are of critical importance in the maintenance of balanced diets. If government price fixing is to be substituted for market prices in the guidance of farm production, it is imperative that changes in fixed prices be made promptly when occasion requires if disaster is to be avoided.

If we produce too little food or the wrong kind of food, no rationing system can increase the physical supply nor change its composition. The first job is to be certain that we produce the needed quantities of the right kinds of food. The next is to see that the people get it who need it.

FOOD SUBSIDIES

The critical problem in food price policy is to provide prices that will insure the required production of essential foods. Failure to do this would endanger the successful prosecution of the war. The subsidy question is

concerned primarily with the problem of who will pay these necessary prices for food.

Farmers, as well as farm organizations, are opposed to the general use of food subsidies. They do not like the arbitrary administrative controls that always accompany subsidy payments. Then, too, farmers feel that war workers are well able to pay the necessary price for food.

If subsidies are to be used, they should promote the objectives of the war food program. From this standpoint, the logical place for subsidies would be to stimulate the consumption of economical and abundant foods, such as potatoes, bread, soybeans, and dry beans and peas, by providing low prices through subsidy if necessary. It would be difficult to avoid the use of some subsidies as incidental to guaranteed support prices to insure ample production of such foods. However, to use subsidies to reduce the prices of scarce foods like meat and butter, on which we must economize severely, serves only to make rationing more difficult.

CAN TOTAL FOOD PRODUCTION BE INCREASED?

For seven consecutive years, 1937 to 1943, the aggregate yields per acre of United States crops have exceeded any year in history prior to this period. In 1942, the total production of all food crops was 24 per cent above the 1935–39 average. The estimated total production of food crops in 1943 is about nine per cent below 1942 but about the level of 1941.

While hybrid seed corn, improved production practices, and conservative measures contributed to these highly favorable results, another major factor was extremely favorable weather throughout the United States.

In view of these extremely favorable yields in recent years, the nation will be fortunate if it can maintain crop production at the 1937–43 level during the remainder of the present emergency even though all possible assistance is given to farmers. In spite of the steps taken, we still have critical shortages of skilled farm labor, machinery, fertilizer and essential supplies.

The extremely rapid acceleration in livestock production (principally hogs and poultry) during the present war was made possible by a succession of phenomenal crops and was stimulated by very favorable prices of livestock products relative to feed. The 1943 production of meat and other livestock products will be about 10 per cent larger than the record output of 1942 because much of it is produced on last year's crops. We are now living on our fat but the supply will decline when the livestock population is reduced to available feed supplies.

Although the present demand for meat and other livestock products is almost unlimited, the total production of these foods is determined by the total available feed supplies. The amount of each will depend on existing price relationships. The prices of hogs have been more favorable than those of dairy and other livestock products throughout the present war period. The importance of maintaining the production of fresh milk and eggs has been stressed again in the recommended food goals for 1944, but the inevitable result of present price policies, unless changed, will be a severe—and perhaps a drastic reduction.

Under the stimulus of the government program, livestock production has outrun feed supplies. The facts have been clearly evident for months. However, livestock numbers (especially hogs in the corn belt) are continuing to expand in spite of inadequate total feed sup-

plies, because ceiling prices on feeds, especially corn, have prevented feed prices from checking the espansion of livestock at a point where all the animals could be fed. The only steps taken to date in regard to this critical situation are an announcement that the floor price of hogs will be reduced from $13.75 to $12.50 per hundred pounds on October 1, 1944 and a request to reduce the weight of hogs marketed and the size of the 1944 spring pig crop. The liquidation will be about over before these remedies could take effect.

The number of grain-consuming animal units on January 1, 1944 will probably be about 10 per cent above last year and one-third above average while the total supply of feed grains is about nine per cent less than a year ago. Thus the available feed supply per animal is about 17 per cent less than last year. Large quantities of wheat have already been used for feed but no effective action has yet been taken to check the expansion in hogs. The only possible way in which feed can be provided for present livestock numbers is to use up the world's last important reserves of human food, wheat. Reduced pig production, marketing hogs at lighter weights, reduced production of choice grain-fed beef, reduced production of broilers and other poultry for meat and less intensive grain feeding of dairy cows all will be necessary to meet this feed situation.

A continuation of present policies will force those producers who run out of feed first to sell out regardless of the need for their product. If prices are not to be allowed to keep livestock and feed in balance, it is imperative that a plan be developed for the orderly liquidation of livestock numbers and the equitable distribution of available feed supplies so as to provide feed for dairy cows and hens. The longer these readjustments are postponed, the more violent and wasteful the resulting liquidation will be and the greater the danger of a serious reduction in the supply of milk and eggs for cities.

FEEDING THE PEOPLE OF EUROPE

During World War I our food exports increased from six or eight per cent of production in the pre-war years to 17 per cent in 1919. About half of this increase in exports came from greater production while the other half came from reduced civilian consumption made possible by changes in eating habits. With 33 million more people to feed here at home our food exports varied between two and five per cent of our production in the years just prior to the present war. In 1943 our Lend-Lease shipments of food are estimated to be only 10 per cent of production while our per capita food output is 25 per cent above the pre-war level. In this war we have increased production tremendously, but with high wages and ceiling prices we have raised our standard of living and have eaten up most of the increase ourselves.

For all practical purposes United States peace-time food consumption has about equalled production with the exception of wheat.

Because of the probability of less favorable weather and the shortage of skilled farm labor, machinery, fertilizer, and supplies, the chances of increasing total crop production above 1942 are extremely remote.

At the same time, the United States is faced with imperative demands for more food. The needs of our allies are growing steadily. Every country released from Axis domination will bring further increases in demand. Sicily and Italy are only the beginning. These requirements are certain to increase during the remainder of the war and will

probably reach a maximum after fighting ends in Europe. At that time, most of the hundreds of millions of people who have been under Axis control will need some food until their own production can be restored and much of it must come from United States farms.

In view of this situation, it seems clear that the answer to the present food problem must be sought in the better utilization of our present food resources. The only way to save much food is to increase the direct human consumption of potatoes, bread, soybeans, dried beans and peas and other crop products and reduce the civilian consumption of meat and animal products. These crops are of first importance in wartime because they provide many times as much energy and critical nutrients per acre or per man hour as meat or livestock products.

Substituting direct consumption of crops for indirect consumption in the form of meat greatly increases the number of persons who can be maintained on a given quantity of crops. Animals are not efficient converters of grains and other concentrated feeds into human food although products richer in certain critical nutrients may result. In converting into livestock products the grain produced on United States farms in 1942 about 86 per cent of their energy value was lost without considering the hay, roughage, and pasture used as supplementary feed.

Any thought of feeding many additional millions of people on the diet to which we have been accustomed is utter nonsense. The 10 per cent of our annual production to be used for Lend-Lease in 1943 would feed about 13 or 14 million people on a diet like our own. The same amount of concentrated foods would supplement the diets of a somewhat larger number of people. However, all told, the United States produced enough crops last year so that if all had been fed directly to human beings, they would have provided the energy requirements for a population more than three times our own.

If many additional millions are to be fed during the present emergency, it must be largely on wheat, soybeans, dried beans and peas, corn and other crop products. Although such a ration is not as palatable nor as adequate nutritionally as one containing more livestock products it will prevent starvation and provide a maintenance diet until European food production can be re-established.

A drastic decrease in our civilian consumption of livestock products is neither practicable nor necessary and only the direction of the change called for is suggested. The question of how far we can go without serious injury to health and morale is a question for the nutrition specialists to answer. The question of how far we are willing to go is a question for the people of the United States to answer. If we do not go quite a way, however, we shall not feed many people in addition to ourselves.

A Wartime Food Program

1. Strengthen and clarify the powers of War Food Administrator so that he will have freedom and authority to plan and carry out a food program within the framework of policies laid down by Congress and the President. At the present time, decision on food policy and operations are made by officials who have neither adequate staffs nor public responsibility for their actions.

2. As the next step in a realistic wartime food program, the War Food Administrator should organize and carry out, in coöperation with the States, an

intensive educational program to point out the facts of the present food situation and to emphasize the patriotic service of civilian conservation of food. It should include a clear statement of the importance of eating more crops and crop products but less meat and livestock products by civilians for the duration of the war. *This is the only way to keep down the cost of a family food budget and at the same time provide prices necessary to maintain production.*

Thus far, reliance has been placed largely on negative controls such as rationing to reduce consumption of choice foods, and threats rather than facts have been employed to make them effective. The public would respond willingly to an appeal which explains why this change in diet must be made as a necessary step toward winning the war and the peace. An important part of this educational effort should be the guidance of the public in how good diets can be maintained with crops and available livestock products.

3. Establish guaranteed minimum prices of essential foods, well in advance of planting and breeding seasons, that will insure the desired production.

4. Increase the production of all important food crops to provide ample quantities to meet any possible need. We have already made a good start but, as suggested in 1944 food goals, we must go further in increasing the production of such crops as potatoes, sweet potatoes, dry beans and peas, soybeans, peanuts, and vegetables.

5. Use the remaining crop acreage for the maximum production of the food crops best adapted to individual farms.

6. Establish prices that will result in the use of available feed supplies for the production of the quantities and kinds of livestock products required to meet war demands and to balance civilian diets made up more largely of crop products.

7. Establish prices that will encourage maximum production of fluid milk and milk solids. There are two essential requirements in the maintenance of fluid milk production, the assurance of an ample supply of food and the establishment of a farm price favorable to feed and other costs. The rapid increase in hog numbers has already jeopardized the feed supply and prompt adjustment is imperative to prevent a serious milk shortage.

8. Maintain the present skilled labor force on farms, and supplement it with necessary seasonal labor. Provide new machinery to replace worn-out machines as well as repair parts, fertilizers, and essential supplies. If a serious attempt is to be made to meet the increased food production goals announced for 1944, substantial additional amounts of skilled farm labor, new farm machinery, fertilizer and supplies will be required.

9. Maintain stocks of wheat, soybeans, beans and other storable food at levels that will enable us to meet any probable demands for human food by European people at the end of the war. Additional wheat should not be fed to livestock until we are certain of the adequacy of the remaining supply to meet human needs. The wheat stocks of the United States and Canada are the only substantial reserves of human food that are available to meet any emergencies that may arise.

10. Give public recognition of the vital importance of the food problems and the patriotic service of efficient food production in winning the war and insuring the peace to follow.

11. Maintain the Victory Garden Program and increase it if possible. The need will be greater next year.

AN ECONOMIC FUTURE FOR JAPAN

George D. Hubbard

THE post-war development of Japan is a matter of concern to many people, especially to those of nations touching on the Pacific Ocean. Japan has made claims of population pressure, for more food, for mineral resources, and for many raw materials. She has claimed a great desire to improve her country and people and the rest of the Orient. Japan has been lauded for her ambition, astuteness, and for her nice, dainty ways, and cursed for her stupidity, treachery, unfriendliness, and brutality.

That Japan has been misguided and, in her modern program and methods, is not modern or civilized seems revealed in the feudalistic spirit of her totalitarian government. That her vision of what is best for Japan involves the subjugation, slavery, or annihilation of other equally important and for millenniums more cultured nations is obvious both from her statements and her activities since 1930.

The repeated question, "What can Japan do?", particularly for herself, has been given several answers which will be briefly summarized. A careful survey must be made and an answer found. No doubt any solution suggested should take stock of what is done to Japan in the peace treaties. Such stock-taking at present is certainly dealing in futures. Yet why delay longer an analysis of possibilities for Japan when stripped of all she has taken by aggression in the last forty or more years?

Japan's Present Status

Structure, landscape—Whether in the remote past the gods walked on an ethereal bridge across the rolling sea and dipped their tridents into the waters whose tumbling drops congealed and became the Japanese archipelagos is today of little consequence. The Japanese geologist knows his islands as the product in large part of sedimentary rocks (two-thirds) and in lesser part of later volcanic rocks. Recent igneous rocks greatly predominate over older eruptives; together they have given rock surface to about one-third of the island area and rare grace to many a mountain slope. In themselves these forms and structures are a cashable asset, the foundation of as charming a setting as Norway or Switzerland possesses.

So recent are most of the rocks that vigorous running water from Japan's generous rainfall has carved mountains not subdued but standing in beauty and ruggedness everywhere. Plains are small and usually tucked in among wild, beautiful mountains, themselves mostly covered with luxuriant green. Hundreds of peaks pierce the sky, several exceeding 10,000 feet. Islands are not large and have relatively high divides giving many short, tumbling streams with a wealth of small perennial water-power sites.

The topographic pattern of Japan is not grand, massive, or majestic, but delicately chased and beautiful. This scenic beauty, the Japanese, a people of small stature, have elaborated by quaint ornamental buildings, gardens formed for miniature vistas and trees cultivated for dwarf effects. Irrigation systems, canals, and rice paddies, terraces, gardens, paths, and roadways

among the greens and slopes, are to be found everywhere in the cultivable land.

Shorelines—Shorelines are deeply indented through the piling of rocks in mountain building and volcanism; and because of recent notable changes of level of land and sea that have set the ocean back into valleys, among peaks, and between ridges harbors abound, and bays, peninsulas, and islands are everywhere present. Over 3,000 islands, hundreds of peninsulas, and an equal number of bays and straits extend the shoreline to more than 18,000 miles. Small changes of sea level would produce great shoreline changes but not change noticeably the length of the line.

Besides the wealth of islands, bays, and peninsulas Japan has among her three southern large islands the far-famed Inland Sea with as attractive a shoreline pattern as any ocean coast, extending its intricate fringe on each side of the sea to a bee-line length of two hundred miles. The Inland Sea may be entered at each end from the Pacific and on the southwest from the Tsushima Strait which lies between Japan and Korea. Kobe and Osaka spread along its shore.

Climate—Ample rainfall and warmth have clothed these islands in the north with conifers and deciduous forests, in the south with subtropical vegetation such as camphor, bamboo, satsumas, mandarins, evergreen oak, and tea besides a rich variety of shrubs and herbs. Yet lumber is found annually on Japan's import list. To the profusion of flowers and seeds come multitudes of butterflies, moths, and birds, many of rare beauty. While not strictly in a marine climate Japan's is tempered by the sea. It is also given a strong monsoon flavor by its marginal position on the great Asiatic continent.

Minerals—For minerals variety is more notable than quantity. Only coal and copper are really important. Iron ore meets only ten per cent of the current needs; gold imports are twice home production; phosphate is insufficient for fertilizer needs; tungsten, lead, zinc, silver, arsenic, and sulphur do fairly well; petroleum measures 100,000,000 gallons annually but is not enough for peace times. Salt is produced from the sea but it only half meets the needs. About half of possible water power is developed, yet nearly every village and hamlet has electric light and power. Recent reports say over 11,000,000 homes use current. There can not be many in the gloom of an oil lamp. Sands and clays are ample for all ceramic needs; limestones, volcanic ash, and clays support an active cement industry.

Fisheries—Temperate, abundant, land-penetrating seas, many of them shallow, promote a brisk and varied fishing industry. In no other country does fish enter as generously into the diet besides furnishing quantities of organic fertilizer; seaweed is digested for potassium and iodine. Glue, fish oils, isinglass, and many forms of cured fish come out of the marine fisheries. Some agriculture is practiced but great expansion of many kinds is known to be possible.

Agriculture—About 15,000,000 acres, or less than one-sixth of the area is arable land. This means about four to five persons per acre, a trifle less than half the people, are engaged in agriculture and these work by hand with simple tools. Many supplement their agricultural income by home industries. No such improvement in agriculture has been made in recent years as in industry. Nearly half the agriculture is devoted to rice culture. Many vegetables and some range of fruits are grown. Most farmers possess their own lands, very small holdings, and all farmers have

scarcely more than 2,000,000 farm animals to help with the work. In general live stock is obviously lacking.

Population—In spite of recent rapid increases in population Japan's food production is still nearly sufficient, and some rise in standards of living has been shown in a larger use of wheat instead of rice and millet, and in a larger use of meat and fruits than a few years ago. Next to the soldier the tiller of the soil is in highest esteem; in few western countries does he hold as high a place as in Japan.

Rate of increase of population since Perry's call in 1853, has been phenomenal and has been encouraged by the oft-expressed feeling in high circles that a high birth rate is a sign of good health, national virility and patriotism. The tide seemed to have turned in the last decade, but since 1940 vital statistics are not made public. To all interested the pressure of population seemed for several years a vital problem. No matter what the real reason for recent military invasion of eastern lands the excuse most often given has been the necessity of land for the worthy expanding population. But a little study of population densities in the Orient shows some invasions, as those of Java, Siam, and much of China, have been from this point of view rather ill-advised or futile.

Smith, Good, and McCune have recently prepared what J. K. Wright correctly calls in its preface a book of facts on Japan. It is economic, historic, and analytic of the present situation in Japan as to physical geography, resources, and population problems. There is gathered here a rich body of data, facts, and statistics, which are presented in telling form. The authors are clear that during the thirties the Japanese method of industrial activity did not solve the problem of providing a rising or stable standard of living.

The plan of territorial expansion while not yet completely stabilized is also considered and is shown to fall far short of the alleged goal of a Co-prosperity Sphere in East Asia. It is even shown to have already nearly wrecked the degree of economic stability formerly attained by Japan.

Some other alternatives must be sought or Japan will not take the place in world economy most desirable to her people, or most able to relieve the political, economic, and social strains upon the Japanese people. Japan is no doubt working on these problems harder than anyone outside the country but men with outside viewpoints may be able to make some suggestions.

SUGGESTED CHANGES

Several recent writers have made suggestions for Japan's improvement. A dozen years ago while the population was still increasing with a rising birth rate as well as a rising death rate, John E. Orchard suggested in *Japan's Economic Position*, several good remedies for Japan.

1. Expansion and intensification of agriculture by terracing higher and wider; reclamation of waste land; improvement in methods; mechanization, limtied to better small tools, only in a small way by tractors and power machinery. Japan's farms are too small for the larger power tools so common in America.

2. Change of diet by increase in green food and vitamins which might increase stature and improve health. Such dietary change is opposed by conservatism.

3. Relief through migration. This method Orchard summarizes by showing that migration to Hokkaido, the sparsely settled northern island, is not important

because it calls for too much change in ways of living. Karafuto is colder and less desirable for Japanese than Hokkaido. Japanese have trouble competing with Koreans both in Korea and on these northern islands. Formosa is hot and moist and Japanese do not take readily to that combination. Japanese go in small numbers to Manchuria as in Korea, and become merchants and bankers, but not farmers; but Chinese go to Manchuria by the million and into all possible occupations. Some Japanese go to foreign lands. They prefer the warm, not too humid countries. English-speaking people are not very cordial to them. Many go temporarily to foreign lands and return after a few years for they are a home-loving people. Brazil, Ecuador, and Peru, receive them and Japanese authorities favor such emigration but relatively few go. Thousands have gone to Mindanao of the Philippines and proved helpful to Japan in invasion of the islands.

4. Birth control. This would mean some change in Japanese philosophy, but movements are under way to promote just this change, and while complete vital statistics have not been issued in several years there seems to have been a strong reduction in births. A reverse change in philosophy and birth rate occurred less than a century ago.

5. Industrialization on a large scale is strongly urged. Orchard feels that products of heavy industry, rails, locomotives, ships, and heavy machines, will probably come to Japan from abroad for many years. He enumerates many home and hand industries that are now being carried on, such as wood work, weaving, bronze and lacquer work, enamel and pottery, textiles, dyes, and printing. The industrial future of Japan seems to be in light secondary industries in highly fabricated goods where labor and skill pay high dividends.

Moulton summarizes present status in natural resources, crops, fruits, sugar, silk, poultry, forests, fisheries, and minerals, and concludes that industrial development is the way out. He states that 90 per cent of iron used in Japan is imported and that 100,000,000 gallons of crude petroleum are produced annually, half enough salt for home use, and phosphorus insufficient for fertilizer needs.

Allen shows how diversification in industry has developed since 1929 and notes the rise of chemical industries, engineering, and toolmaking, with a relative fall in textiles and raw silk. He points out that recent economic policy has included increased government intervention, even to control in several lines of industry. He mentions increasing efficiency in spinning of cotton and worsteds, in the rayon industry, and in a number of "western style articles." These years of war have curtailed imports as well as exports and lowered living standards, besides absorbing enormous quantities of raw materials.

Recently a Japanese writer, Nagaoka, discussed Japanese trade and industry, present and future. He points out that the Japanese make a light, tough paper of mulberry bark suitable for bond and bank-note printing; they make fish oil, iodine, potassium, fertilizers, and many small products from fish refuse and seaweed. Japan is gaining mastery over her physical surroundings. The government is encouraging several industries, sugar, dyestuffs, steel, ammonium sulphate for fertilizers, but it gives no help to ceramics, rayon and cotton spinning. He notes that even though Japan makes 2,500,000 bicycles, many electric supplies, bulbs, and batteries, she still has to buy heavy

machinery of steel and iron and that this is a great weakness which Japan could overcome by developing heavy industry. He states that Japan is poor in minerals but self-sufficient in foods. He finds iron ore reserves are about equal to American Lake Superior production for one year and there is a real shortage of nickel, mercury, antimony, aluminum, platinum, potassium, wool, and petroleum. He tells us that Japan has thirty shipyards and is producing 1,000,000 tons a year. These are mostly small vessels; 4,000 recently constructed have a capacity of only four million tons. This includes no warships. Birth rate has ceased to increase, has been "stable for ten years," and may now decline some but men are living longer even though the death rate is still high. Illiteracy is declining, culture is rising (over 99 per cent learn to read and write in childhood).

General Reflections

The Japanese are keen, intelligent, imitative, ambitious people. They are very appreciative of art and beauty. They believe in education, both general and elementary, and for those who can take it and use it, full college, technical, and university training. They believe in medicine, health, science, and a persistent industrious life. What peculiar economic opportunities does a mountainous island home offer to such a people?

Agriculture—Improvement in agriculture is possible in seed selection and breeding, in some methods of cultivation, in introduction of new plants from foreign lands, in development of hybrids, of cereals, vegetables, and fruits. In many places crop rotations may be more systematically practiced, adapted fertilizers used, and better tools and cultivation employed. Rice accounts for half the agriculture. It can be varied with such crops as water chestnuts, peanuts, sweet and Irish potatoes, pulse, sugar beets, and many tree fruits, nuts, and vines; the latter group over slopes where rice cannot be grown. Fruits of the currant, gooseberry, blueberry, and blackberry genera should be introduced and bred up. Research men and women in universities and experiment stations can do great things for Japan's agriculture.

Sheep and goats can feed on some land that is now waste and furnish milk, wool, leather, and meat. Poultry and eggs are not overproduced and, if used more, will vary and improve the diet. Stone fruits, such as cherries and plums, can be grown on slopes not cultivable; quinces may also be grown more. Many flowers, lilies, clematis, wisteria, peony, chrysanthemums, may not only adorn but give motif for art and can also contribute to the range of perfumes.

Hill slopes now in scrub and waste can be made productive with mulberry trees for expansion of silk growing; wood of the box, a strong, close-grained material for fine combs; cypress for lacquer work, and Japanese elm for cabinet work. Many of these more or less artistic products fit well into home and village industries and supplementary work. Both materials and products can be handled by coöperatives.

Textile industries—The Japanese could manufacture more of their silk into rich cloth; embroider more, and in every move add to the value of the raw silk. Japanese are inventive to a sufficient extent to make many new patterns and combinations, and imitative enough to reproduce almost any desired pattern. Silk production can be increased so that tons can be retained at home for the weaving and needle artists and still leave as much raw silk to sell as is now exported.

The people work in jute, flax, hemp, wool, and hair from imported stocks. Some of these materials can be produced at home. Thousands of acres not grazed now could supply fine breeds of sheep with food. Flax for linseed oil, oil cake, and linen fibre would add to agricultural possibilities as well as to industrial activities. Needle work in linen, silk, and wool are splendid household industries upon which the Japanese thrive. Tool and type making, paper manufacturing, art printing, work in bone, shell, feathers, horn, and precious stones can be expanded. They prefer to make industry a part-time occupation supplementing agrarian and fishing interests. Motif for art work can be found in the beautiful butterflies, birds, waterfalls, ferns, cedars, mountains, shorelines, and in shells and plants of the sea. Japan has an unusual variety in most of these designs of nature.

Metal industries—More power is needed for light metal work. The very limited supply of iron and alloy metals means either the purchase of ore or of steel or the purchase of the finished products of all heavy metal industries such as bridge, rail, and car building, large machinery for mining, construction, lumbering, and shipbuilding. Japan should abandon most of her heavy industry. Copper, zinc, and lead are sufficient and tin can be purchased in the Orient and put into copper alloys such as brass and bronze. These offer the material for a large range of small industries from the making of keys, locks, pins, and candlesticks, to the production of ornaments, clocks, watches, balances, and precision and musical instruments of many kinds. In all this range of products the skill, patience, art, and labor can be sold with a small amount of metal; and skill and art are improved and not depleted with the using. With as skillful imitators as are the Japanese many branches of the metal, lacquer, and enamel arts can be developed; damascene, champlevé, cloisonné, fine jewelry and other combinations of metal and lacquer are before the artist. New England might never have made the grade without the manufacture of Yankee notions.

Ceramic industries—Japanese for generations have been skilled in pottery, china ware, and porcelains, and now make art glass. They can make sheet and plate glass to replace their lattices and paper windows. They have high-grade clays and sands and can enlarge their production of fired wares in several directions. Insulation goods, and electric appliances are lines well adapted to development. Again inventive genius in design pattern, skill, and persistence all count without using more materials and fuel than in making jugs and stone ware.

Chemical industries—from Japan's peculiar or indigenous plants, such as peppermint, oil trees, camphor, and spice trees, production can be enlarged using more men on the soil and in the woods and more men and women in the laboratories where the products are prepared. Camphor trees grow in the south and their products produce celluloid and commercial camphor. Menthol comes from peppermint easily grown in Japan's climate. Coal can be coked, and the by-products worked into dyes, tar, and ammonia would furnish more work and higher valued products than does the coal itself. Sulphur and sulphide ores furnish the basis for a series of chemical industries starting with sulphuric acid and ending with drugs, medicines, and fertilizers. Salt production can be expanded to meet all instead of half the national needs and then contribute to several chemical industries, leading to soda ash, disinfectants, bleaching powders,

and more medicines. France, Norway, and Switzerland suggest much in these fields for Japan.

Sundries—Silver-thread work, gold thread in silk brocades and tapestries, dyes in new and rich colors devised for fine silk, cotton, linen, or wool open many possibilities. Making fine mulberry paper, printing on fine paper and cloth, carving in wood, ivory and metal, making of toys, manufacture of perfumes from the wealth of wild or cultivated flowers grown in the stimulating climate offer other fields.

The bamboo, willows, and grasses provide material for baskets, furniture, rattan goods, wicker work, mats, screens, shades, and blinds. Volcanic ash, limestone, and clays may form the basis for expansion of cement industries, and manufacture of brick and concrete blocks by which more substantial buildings and roads can be made.

The hydroelectric power can be used to fix nitrogen and prepare fertilizers to strengthen agriculture. Only half the possible hydroelectric power has been developed. A further expansion of water power could furnish electricity for the development of the many home and village industries already discussed.

Japan's art has developed in two directions. For centuries there has been the fine, slowly executed high-grade product of the artist, the slowly matured hand-work of a lifetime. In contrast, recent years have seen the factory-manufactured, flimsy, sometimes tawdry art notions sold cheaply in our five and ten cent stores. Is there a middle ground which will offer work and subsistence to many and bring pleasure to all concerned? Is there possible a mass production of needed notions whose products will be substantial enough for real use and whose designs will be artistic enough to please both seller and buyer?

America and Britain are demanding markets for their goods. Some people feel that we should not encourage other nations to manufacture because that puts foreign goods in competition with ours. But how can foreign nations buy of us unless we buy of them? And, further, competition with Japan would not be so keen in these products if manufactured at home as if made here. These suggestions anticipate generous complementary trade by America and England with Japan but with the Japanese living largely at home in their familiar environment. A part of American and British contribution to world peace and economy must include reciprocal trade and we must buy first that they may have the means to buy.

Shipbuilding and commerce—The Japanese islands are not as well blessed with shipbuilding lumber as with harbors, but Russian and Canadian forests are no more distant than were New England forests from Britain in the sixteenth and seventeenth centuries when her shipbuilding flourished on New England planks and spars. No island people should neglect shipbuilding and the carrying trade. Someone must carry the products of continental lands. Japan can supplement her income materially by carrying goods. Shipbuilding requires metal but merchant marine needs less than warships. Soils and topography do not repel in Japan as strongly as they do in Norway and the harbors and the sea are just as inviting. Carrying trade and some shipbuilding should be encouraged.

The tourist trade—Thousands of American tourists cross the Atlantic to see the beauties of Switzerland and it has no shorelines, Inland Sea, or volcanoes. Japan has the Switzerland of Hondo or the Japanese Alps and a climate for the sightseer's comfort all the year round. Japan has no glaciers, only a few snow

caps, but there are cascades and falls, beautiful streams, hill and mountainside terraces, and the picturesque cottages, villages, and people throughout the hills and the valleys. One of the attractions for a tourist is a different people together with their culture and architecture, and these abound in Japan for the American and the European.

The Japanese are a hospitable, friendly people able to care for tourists and by preparing homes, inns, roads to classic places, and making other adaptations over a period of years they can give a tourist as royal, inspiring, instructive, and lasting an experience, though vastly different, as he could get in Switzerland, France, Norway, or England.

Conclusions—There are many Japans: rural Japan; game and fishing Japan; shrine Japan; industrial and urban Japan; artistic Japan; educational and Christian Japan.

No Japan in its present state of mind and servitude can fit into the above picture, but Japan is due for a change. An honest government and an honest people, a change of foreign policy, a liberation of the people are necessities to the consummation of the program. The abandonment of heavy industry presupposes a psychological change in their adoration of war, and a willingness of western people to purchase high-grade, expensive, artistic products and to accept their competition in the five- and ten-cent store trade. Higher standards of living in Japan will further open Japanese markets to us and ease the price competition. Some competition in the world's markets is far better for us than all this blasting war.

With these changes of mind, heart, and policy most of the suggestions are possible of fulfillment through a period of years. They contemplate a long-range program to be started soon but not to be immediately completely adjusted. If such adjustments are given a chance by the Japanese people, their rulers, and the United Nations, they will produce income, a way of life, and a place in the economy of nations, of which Japan may some day be proud. Increase of efficiency, artistry, and improvement in technology are already under way. Post-war reconstruction must help.

Japan can and should be shown that there is a better way out of the economic slough of despond than the road of the aggressor and transgressor, always hard; and that her people may better find honor and prosperity among the nations by the way of peace.

THE INDUSTRIAL DEVELOPMENT OF THE ALLEGHENY VALLEY OF WESTERN PENNSYLVANIA

E. Willard Miller

THE Allegheny Valley, a part of the industrialized valleys of western Pennsylvania, is the most important industrialized area north of Pittsburgh. The valley, which has approximately 60,000 workers in manufacturing plants, is in sharp contrast to the uplands where agriculture, foresting, and extensive stretches of waste land prevail. However, the industrial activities of this region are frequently disregarded when considering western Pennsylvania as an industrial unit. This is due primarily to three factors, first, the towns are principally one industry developments, second, no cities are large enough to appear in the United States Census of Manufacturing, and third, of the three major valleys, Monongahela, Ohio, and Allegheny, the latter has the least industrialization. The statistical information in this report is taken largely from the Pennsylvania Industrial Directories from 1916 to 1942, and the publications of the Bureau of Business Research, University of Pittsburgh.

The modern Allegheny can be divided into three industrial sections. The lower part from Kittanning to Pittsburgh is highly industrialized with the production of iron and steel, machinery, aluminum, plate glass and other heavy products. The cities of this section have had their greatest increase in population since 1870. Their growth is directly associated with the development of Pittsburgh as the nation's leading steel center. The central district of the Allegheny between Kittanning and Franklin is sparsely populated and has little industrial development, principally because of the narrowness of the valley bottom. From Franklin to the headwaters the exploitation of petroleum and lumbering and their allied industries is of primary importance.

Physical Setting

The Allegheny River is the major stream flowing through the northern portion of the unglaciated Allegheny Plateau. The river rises in northern Pennsylvania, enters New York state for a short distance, and then takes a general southward course in Pennsylvania for 214 miles to Pittsburgh where it joins the Monongahela to form the Ohio River. At its source the dividing ridges between the Allegheny, Genessee, and Susquehanna Rivers have an altitude of 2,500 to 2,600 feet. There is a gradual descent toward the mouth of the river, the ridge altitudes near Oil City are 1,600 to 1,650 feet, near the Clarion River 1,550 feet, and at Pittsburgh 1,200 to 1,300 feet. A comparison of these altitudes with the altitudes of the river shows that the stream flows 500 to 800 feet below the highest points. Altitudes favor deep valleys and the presence of resistant sandstone at the surface in many places causes the valley slopes to be steep and rugged. The Allegheny River with its tributaries drains approximately 11,730 square miles.

The preglacial drainage of this river system was probably essentially different from today. Although only a

small portion of the Allegheny system was affected directly by glaciation, the present river owes its origin to the continental glacier. The preglacial Allegheny was divided into three parts, the Upper, Middle, and Lower. Each was a distinct stream which drained northwestward into a major river in the present Lake Erie basin, the Upper by way of the Cassadaga Creek, the Middle through French and Conneaut Creek, and the Lower Allegheny by way of the Beaver and preglacial Grand River.

The changes caused by glaciation have had a decided effect on the present topographic setting of the valley. As the continental ice sheet approached from the north the northern outlets were blocked, and the streams kept a southern course so long and so modified the ancient valleys that the three streams were combined draining in the opposite direction and forming a system tributary to the Mississippi River. As a result the preglacial channels exhibit characteristics of maturity while the connecting channels are still youthful

FIGURE 1.—Location of the Allegheny Valley of western Pennsylvania. Notice particularly the concentration of cities near Pittsburgh.

FIGURE 2.—The Allegheny Valley showing the mouth of the Clarion River.

or in early maturity. The preglacial channel, from its headwaters to Kinzua, varies in width from three quarters to a mile. At the old divide below Kinzua it narrows abruptly to a width of one quarter of a mile, and continues narrow nearly to the mouth of Conewango River at Warren. From Warren to French Creek at Franklin the valley once again becomes wider. The area between the Clarion River and French Creek is scarcely more than one-fourth mile wide, and rarely exceeds one-half mile in width presenting a gorge like appearance with little floodplain and few precipitous slopes. At the mouth of the Clarion River the valley is in the early maturity stage of development (Figure 2). A broad preglacial plain comes in from that valley and continues down the Allegheny to its mouth. This plain has been trenched to a depth of about 200 feet, forming a series of upper terraces. Nowhere do these terraces become wide enough to allow for more than a minimum of space. The inner valley is usually about one-fourth to one-half mile in width, though it increases to nearly a mile near the mouth. The valley, therefore, is characterized by entrenched meanders, abandoned preglacial channels, and narrow intermittent flat bottom lands bordering first one side of the river and then the other. The physiographic setting has greatly influenced the settlement pattern. The cities and villages are located in the mature areas while youthful areas are still largely uninhabited.

THE ROLE OF TRANSPORTATION

The Allegheny Valley since pioneer days has been the principal transportation route for northwestern Pennsylvania to and from the Pittsburgh district. Since the major industries of the region are characterized by manufacturing plants consuming heavy raw materials, producing bulky products, and a rapidly growing coal industry, the transportation facilities are of major importance. Waterways, railroads, and highways, the leading elements of the transportation picture, serve to connect each part of the region as well as to connect this region with other areas.

The Allegheny River has never been classed as an excellent waterway for navigation. The river is likely to be frozen from December to March, with ice piled in great packs and jams in many places. In March and April the heavy spring rains frequently cause floods that are tremendously destruc-

tive. In the course of 48 hours the Allegheny has been known to rise from a nominal stage of three feet to over 40 feet—on March 18, 1936 at Pittsburgh to 46 feet. After the spring floods from May through June the river slowly falls and that is the best time for navigational purposes. During the summer it is barely more than an overgrown creek. Once again in the fall with the autumnal rains the river rises and navigation is resumed until it freezes in December.

The river had its heaviest traffic with the development of the natural resources of iron ore and timber in the 1840's and 1850's and petroleum in the 1860's. The first lumbermen appeared about 1830 and the rafting of timber downstream began. The rafts were frequently of tremendous size, commonly from 50 to 60 feet wide and from 200 to 250 feet long. At the peak of the traffic in the 1850's there were occasionally 40 to 50 rafts floating in a pack stretching for miles along the river. It is said that more than 1,000 rafts came down the Allegheny annually. After the Civil War the number of rafts decreased and the last one was sent down the river in the early 1880's.

In the 1840's the iron furnaces along the central Allegheny produced pig iron that was used in the growing iron industry in Pittsburgh. In Clarion, Venango, and Armstrong Counties there were numerous loading docks. The peak of the iron traffic was reached about 1855 and had almost disappeared by the Civil War.

The heaviest traffic of the Allegheny developed after the discovery of petroleum in the Oil Creek fields. There was only a limited market for petroleum in the Oil Region so the major refining centers developed in Pittsburgh. In 1860 pipe lines were not in use and no railroads entered the Oil Region so the most expeditious way of handling the crude was to ship it down the river. From 1860 to about 1867 some 2,000 crafts of all descriptions were used for transporting petroleum, equipment, and men to and from the oil fields. It was common for 150 to 200 boats carrying 10,000 to 20,000 barrels of oil to pass downstream in a pack. While an oil fleet lay at anchor a sudden flood, the breaking loose of an ice gorge, or fire occasionally endangered it. In 1862 an ice gorge came down Oil Creek crashing against 350 boats at Oil City with 60,000 barrels of oil aboard destroying over half the boats and oil with a loss of $350,000. Since the shipment of oil was hazardous and could take place only during the high water periods the extension of the railroads into the Oil Region and the building of pipe lines after 1865 caused the traffic in petroleum to disappear by 1868.

The Allegheny had its greatest use as a transportation route before any navigational improvements were begun. Virtually 90 per cent of the steamboats were built prior to 1880. The first efforts to improve the river came in 1878 when boulders, snags, debris, and the construction of low dikes to direct water to deeper channels were undertaken. These early improvements were followed in 1886 by an appropriation for the construction of a dam in the vicinity of Herr's Island. Considerable difficulty in acquiring land rights was encountered so the dam was not completed until 1903. By that time the Monongahela River had 15 locks affording slack water navigation to its headwaters. The development of the coal resources along the Monongahela came at the same time when there was much national interest in developing the internal waterways while the Allegheny had its peak before this period. Since

1903 eight additional locks have been constructed on the Allegheny extending slack water to East Brady 70 miles upstream. The river has 48 terminals along its banks. In the movement of coal, iron, and steel it is much less important than the Monongahela, but more sand and gravel which lie on the high terraces, in the abandoned loops and in the river bed are preferred to those on the Monongahela and Youghiogheny Rivers because they contain more crystalline pebbles. As more coal seams are opened, the shipment of coal by water is increasing. Large quantities are now being taken from Harmarville to Wheeling, West Virginia where it is used in the steel mills. At the present time there has been a definite halt in the construction of dams for little traffic would originate in the central or northern portion of the basin.

The river was the first highway but because of its navigational hazards, the railroad soon after entering the valley, became the principal means of transportation. The Allegheny Valley Railroad was built northward from Pittsburgh to Kittanning in 1856. With the need of transportation facilities in the Oil Region the railroad was extended to Oil City in 1865, and northward to the headwaters by 1885 as new oil pools were discovered. Topography has been a limiting factor in the building of railroads in western Pennsylvania so that the most feasible locations are the narrow river lowlands. Even here tunnels are necessary in a number of places. Since the river bottoms are limited the space occupied by the railroads is considerable. At most places they are a prominent part of the cultural landscape (Figure 3).

At the present time the valley is served by three lines. The main branch of the Pennsylvania Railroad from Pittsburgh to Buffalo follows the east bank of the river to its headwaters. This is the principal passenger and freight carrier of the valley. The Pittsburgh and Shawmut Railroad enters the valley at Mahoning, 56 miles north of Pittsburgh, and is primarily a carrier of coal and local freight. The Baltimore and Ohio is found in the lowland for short distances between Etna and Pittsburgh and Parkers Landing and Foxburg.

Paved highways are the most recent addition to the transportation picture. They are not as restricted in their location as the railroads. Along the southern stretches of the river, wide highways are found on both banks. However, in the central and northern sections many miles are without improved roads. While the highways are not as important in the movement

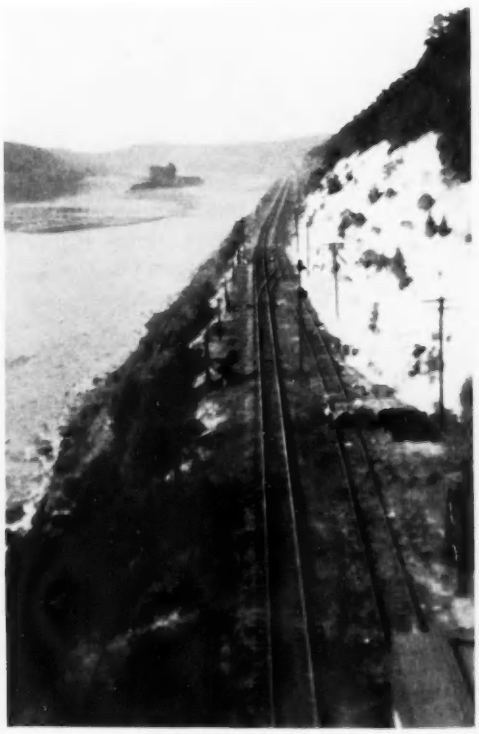

FIGURE 3.—The railroads are a conspicuous part of the landscape. In many places the valley is so narrow there is barely space for the tracks.

of bulky goods as the railroads they are indispensable, particularly near Pittsburgh, for the transportation of people by bus and automobile.

Natural Resources of the Allegheny Basin

The exploitation of the natural resources of the Allegheny Basin has been an important basis for industrial activities. The development of these resources has not been uniform and frequently retarded because of the ruggedness and inaccessibility of the area. The exploitation of the white pine forests was one of the first motivating influences for settlement. By 1830 the forests of the populated regions of the eastern seaboard were becoming exhausted and the first lumbermen trickled into the region. Development of the lumbering industry proceeded slowly for a number of years for the only way to get the timber to market was to float it down the streams. However, by 1850 lumbering and its related industries were well established businesses. There were many saw mills on the major streams as well as the smaller tributaries.

As the timber was cut back from the streams an elaborate system of transportation was developed. White pine was usually cut in the late fall and winter, but was not hauled to the mills on sleds as in New England or Michigan for the terrain was too rough and the snow not sufficiently deep. The logs were skidded to the nearest stream, many of them so small that flood dams had to be constructed which would impound the water until enough logs had accumulated to make it worth while to release the water, and start them on the way downstream. The first saw mills were powered by water, but the streams were small and during the dry season lacked sufficient water so that steam powered mills began to appear about 1855.

White pine timber was of greatest value and first to be exploited. Hemlock began to be utilized in the 1850's for the tanning of hides. Hemlock was cut principally during the summer months when the bark could be peeled easily. Most of the logs were not used and were allowed to lie where they had fallen. Whole hillsides were left covered by the stripped logs. There are few examples of greater waste in the history of the lumbering industry. By 1875 Port Allegheny was one of the leading tannery centers in the United States.

With much of the settlement of the Midwest, lumbering was a part of the process of clearing the land for agriculture. The farmer usually augmented his income by cutting a few cords of wood during the winter months. This method of clearing the land was rarely practiced in the Allegheny Basin. In the northern part of the basin, particularly the development of lumbering, retarded the clearing of the land for agricultural purposes. Only white pine, some hemlock and cherry were cut so the land was only partially cleared.

By 1880 much of the virgin timber had been cut but second growth stands were fast developing. As a result the forests are still the most conspicuous part of the landscape (Figure 4). Some of the most extensive forests of the state remain in the region. McKean County has 90 per cent of its land in forests, while Elk, Warren, and Forest Counties have nearly as much land in woods. The Allegheny National Forest occupies 600 square miles in these counties, and in Clarion County, Cook's Forest is the largest tract of virgin timber in eastern United States. The largest lumber cutting enterprise of the state, the Central Pennsylvania Lumber Company, is located at Sheffield on

Tionesta Creek. A number of small towns have wood chemical factories employing five to fifteen workers and produce charcoal, acetate of lime, and wood alcohol. The northern Pennsylvania forest is one of the largest game areas in the East so that there are many hunting lodges used during the deer season in December.

FIGURE 4.—The forest landscape of the northern Allegheny Basin.

South of Oil City woodlands occupy approximately 50 per cent of the land. These forests are largely second growth stands of oak, maple, and birch. The timber is not being used extensively at present although there are small portable saw mills that move from tract to tract. Extensive areas are covered with thorn trees that have no economic value. Silva culture has been practiced in limited areas in the past ten years by the Civilian Conservation Corps. Pine and hemlock which will yield a timber crop in 35 to 40 years have been most extensively planted, but greater development is needed in this natural forest region.

The modern oil industry began in 1859 on Oil Creek, a tributary of the Allegheny, where the first successful oil well was drilled. From 1859 to 1865 the Oil Region was confined to the lowlands of Oil Creek and extended forty miles up and down the Allegheny River. As the market increased exploration extended to the uplands and new oil territory was added until by 1885 the Oil Region stretched from Pittsburgh northeastward to southern New York state. In 1885 the Allegheny Oil Region was the only important petroleum district in the United States.

The development of the oil fields was one of the most important factors to attract people and industry to the Allegheny Valley. As each new pool was opened thousands of people came to the region. Such boom towns as Oil City, Franklin, Titusville, Pithole, Shamburg, Oleopolis, Turkey City, Babylon, Parkers Landing, Warren, Bradford, and many others grew from small lumber camps to cities of 5,000 to 20,000 people in a few months. Only those that were favorably located were

able to survive the boom period. The desire to get something for nothing, the reckless disregard of the balance between consumption and production, the habitation of a wrecked and gutted environment were characteristic when no consideration was given to the future. The pioneer oil region was developed during a period when there were no efforts to enforce a controlled drilling program. Petroleum is a migratory mineral and since oil leases were usually exceedingly small and privately owned each producer had to drill more wells and at a greater rate than his neighbor if he was to secure his share of the petroleum. Such a program meant that tremendous quantities of oil field equipment were needed immediately after each new discovery.

The peak production in Pennsylvania occurred in 1891 when 31,424,206 barrels were produced. Production declined steadily for a number of years and at the turn of the century it was thought the Pennsylvania oil industry was nearly finished. With the introduction of secondary recovery methods, however, the downward trend was reversed about 1912, and from 1925 to 1937 a pronounced upward curve was established. Production declined from 1937 to 1940, but under the stimulus of increased drilling due to the war demands petroleum output has increased.

The modern oil region of the Allegheny Basin is divided into two districts, the Northern, composed of the Bradford-Allegheny fields, and the Middle extending from Kane to Butler. The Bradford-Allegheny fields are the principal producing district of the Appalachian Oil Province as a result of rejuvenation by repressuring the oil sands by water. In applying water flooding, the old pools are redrilled using a definite pattern of well-spacing, the most common being the "five spot." With this system leases are laid out in small squares usually about 500 feet on a side. Wells are drilled at each corner of the square for the injection of water into the oil sand. The water under pressure pushes the oil toward the center where the productive well is located. In 1943 the Bradford field produced 13,684,186 out of a total state production of 25,843,000 barrels.

Water flooding has not been successful in the Middle District, which consists of a large number of pools, highly irregular in size and shape, nearly all of which are of the stratigraphic type. Repressuring has been partially successful by injecting a mixture of gas and air into the producing horizon of several pools. Although this district has an estimated total reserve of 2,074,457,000 barrels, only 263,300,000 barrels are recoverable under present production methods. The present output is fairly stabilized, but the average production per well is less than one-fourth barrel per day so that peak production is long past and the "stripper well" stage is definitely established (Figure 5).

The economy of the central and northern Allegheny Basin is based predominately on the exploitation of petroleum so that any change in the production curve is immediately felt, for it affects the means of making a

FIGURE 5.—Because of the narrowness of the valley, many of the wells of the oil region are found on piles on the river bank.

living for most of the people of the region. Production has been increased temporarily during the war emergency, but unless a new technique of petroleum recovery is developed the post war trend will once again be downward. As the oil industry disappears there must be an adjustment to a new and different means of making a livelihood; thus, the economy of the petroleum regions will be the ones most likely to show the greatest changes in the future.

The region through which the Allegheny flows contains the greatest reserves of bituminous coal in Pennsylvania. Since coal mining began in the southwestern part of the state the better quality coals are nearing exhaustion in that region, so that within recent years coal mining has increased in importance north of Pittsburgh. In this region 20 coal beds are found of which the Upper Freeport and Lower Kittanning have great value over extensive areas. The Upper Kittanning, Lower Freeport, and Pittsburgh seams are mined in restricted areas. Several other beds are mined locally but at present have little economic value. More than 75 per cent of the mining is concentrated in the Allegheny Valley and its major tributaries (Figure 6).

The Lower Kittanning beds contain approximately 1,250,000,000 tons of recoverable coal in Allegheny, Armstrong, and Clarion Counties. The coal is from two feet six inches to five feet thick, and averages three feet six inches. In some places a bone parting one to three inches is found. The coal is bright, has a columinar cleavage, is soft, but mines in fair sized lumps. The Lower Kittanning coal averages 37.5 per cent volatile matter, 50 per cent fixed carbon, 3.5 per cent sulphur, and 8 to 9 per cent ash. With the exhaustion of the high volatile coals of the Irwin Basin of Westmoreland

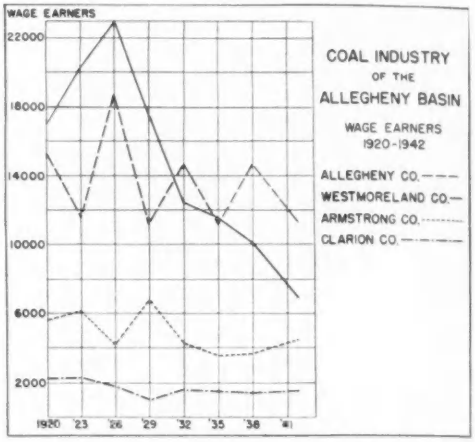

FIGURE 6.—Wage earners in the coal industry of selected counties.

and Fayette Counties this coal will be used extensively for manufacturing gas. The principal mining districts are along the Allegheny River and Red Bank Creek.

The Upper Freeport coal is one of the most persistent and valuable coal beds of the Allegheny region. The recoverable reserve in Allegheny, Armstrong, and Clarion Counties is estimated to be 1,542,500,000 tons. Its best outcrop is in the bank of the Allegheny from the type locality at Freeport downstream to New Kensington where it reaches a thickness of seven feet. The bed averages six to eight feet in places, and from three to six feet in much larger areas and under three feet in possibly more than one-half of the area underlain by it.

The common location of the coal mines in the valleys is due to the ease of reaching the coal outcrops by drift or slope mines. There are few shaft mines in the region. The railroads are also found in the valleys and a large percentage of coal is consumed in the industrialized areas of western Pennsylvania, but a substantial proportion is sent to New York, Ohio, New Jersey, New England, and Canada. Another

considerable quantity is taken by the railroads for their own use.

Small mining communities occur where there are mines of any size. Harmarville, Cadogan, Braeburn, Red Bank, Sarah Furnace, and Barking are typical coal mining towns. They exhibit characteristics of impermanence, as is true of many towns whose industries are based on destructive exploitation. Many of the villages are company owned, with rows of similar houses and a company store (Figure 7). The poorly constructed cheap frame houses, unpaved streets, poor sanitation, and lack of modern conveniences indicates the companies plan to mine the coal and then abandon the site for new locations.

A conspicuous feature of all mining towns is the coal tipple at the mine entrance and the massive piles of shale and bone coal. Many of these piles are smoldering masses that have been ignited by internal combustion. The sulphur fumes are nauseating and the smoke from this source as well as from locomotives quickly destroy the appearance of the newly constructed towns.

The Allegheny Basin has a number of other resources which have influenced local developments. The shales and the buff and red clays are used in the manufacture of red faced brick and hollow tile. There are plants at Creighton, Harmarville, Barking, Sharpsburg, Kittanning, Cowanshannock, and Templeton. There are no good building stones in the region. Limestones are thin-bedded and nodular and are not suitable to be dressed into desired shapes. The fresh water limestones are used by the farmers to make agricultural lime by burning in open piles. The sandstones are soft and are used principally for rough masonry, walls, and gutter dressing.

METALS AND METAL PRODUCTS

The Pittsburgh district was the first area to develop a thriving iron and steel industry west of the Alleghenies. The industry was well established by 1800, and increased greatly in importance after the United States Government constructed the Allegheny Arsenal in 1814. As the plants spread up the valley such farming communities as Etna, Sharpsburg, Aspinwall, Millvale, and Brackenridge owe their early pros-

FIGURE 7.—Typical homes in a coal mining settlement.

perity to iron foundries. At first, blooms were brought from the Juniata district, but by 1825 iron furnaces were starting along the central Allegheny and Shanango Valleys and began furnishing a large part of the material used by Pittsburgh's forges and foundries.

The early iron furnaces which developed in Clarion, Armstrong, and Venango Counties secured their raw materials locally. The ore was mined generally from drifts and banks; sometimes when it was near the surface strip-mining was practiced. Charcoal was the fuel used. Almost every wood except hemlock was burned in small clearings called "coalings or hearths." Chestnut produced the most charcoal of the wood used. Approximately 200 bushels of charcoal were consumed to each ton of metal produced. The ore averaged 45 per cent iron, and it usually required about three and one-half tons of ore and about 500 pounds of limestone as flux to secure one ton of pig iron. The furnaces were small, producing 15 to 60 tons of metal per week. They reached their peak about 1850 when more than 50,000 tons of pig iron were produced annually. The furnaces were beginning to disappear by 1855 and were gone by 1870 because of the depletion of timber, increasing cost of local ore, and competition of large coke and anthracite stacks with importation of Lake Superior ores.

As the iron furnaces declined along the central Allegheny the first blast furnace of the Pittsburgh district was erected in Millvale in 1858. From about 1860 to 1875 the blast furnaces were concentrated along the Lower Allegheny from Millvale to Etna. In 1870 the two Isabella furnaces at Etna and the Lucy furnace at Millvale were astounding the world in tonnage produced. Daily output was in excess of 100 tons, and annual production of 24,000 tons per furnace was the largest the iron industry had yet seen. From 1855 to about 1875 anthracite was the principal fuel. In 1875 bituminous coal took rank over anthracite. As a result new blast furnaces were constructed along the Monongahela where the important Pittsburgh coal seam had its greatest areal extent. The iron and steel industry along the Allegheny was on the periphery of the new center of development. Therefore its growth has been much slower and has never reached the proportions of that of the Monongahela Valley. However, as the coal beds are nearing exhaustion south of Pittsburgh and with the increased use of electricity, specialty steels along the Lower Allegheny have had an important growth.

At present both primary and secondary metals are produced in the valley. The primary metal industries are concentrated within 30 miles of Pittsburgh while secondary metal plants are found throughout the region. The metal industries employing over 30,000 workers are the most important manufactures of the valley (Figure 8). During the past 20 years the areas near Pittsburgh have experienced the greatest gains. The trend of industries has been to move from the congested sections into the less densely populated districts on the outskirts of the geographical city.

Etna, Brackenridge, Blawnox, and Braeburn are the principal primary metal producing centers. Etna has the only blast furnace of the region with a yearly capacity of about 160,000 tons of ferro-manganese steel. At Brackenridge, the Allegheny Ludlum Steel Corporation is one of the largest producers of stainless steels and other ferro-alloys. The acidic and basic open hearth furnaces and electric cru-

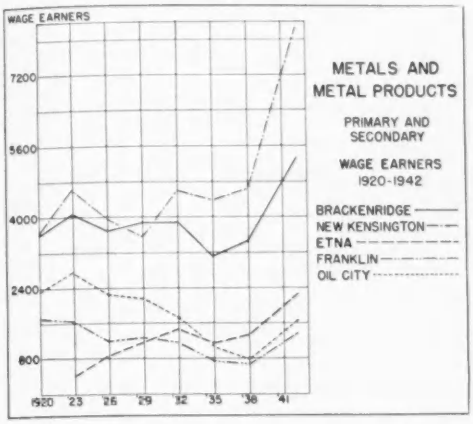

FIGURE 8.—Wage earners in metal and metal products of selected cities.

cibles are used to produce annually 1,150,000 tons of steel ingots, blooms, billets, and hot rolled products (Figure 9). The Lower Allegheny Valley is one of the leaders in the production of these specialty steels. As yet stainless steels are relatively insignificant when compared with total steel production, but the production of alloy steels is growing rapidly. It is likely that this branch of the steel industry will continue to operate in the region and has become an important factor in determining growth in local industrial activity.

The production of secondary steel products is closely allied to the manufacture of primary metals. There is a tendency to specialize in relatively heavy products because of the nearness of basic materials and market conditions. More people are employed in the manufacture of finished steel products than in the primary industry. The Spang Chafant Corporation of Etna, organized in 1828, is an important producer of pipe and tubing in the Pittsburgh district. The Allegheny Ludlum Corporation in recent years has turned to the production of specialty goods such as tableware, decorative metal dishes and novelties. Small plants in Verona and Swissvale produce railroad equipment. Almost all of the towns have plants producing one or more of such products as machinery, machine tools, nuts, washers, hardware, structural shapes, saws, and forgings.

The area between Brackenridge and Franklin, a distance of more than 100 miles, is of minor importance in the manufacture of steel products. In Venango and Warren Counties more than 95 per cent of the metal industries are in the river towns. Since 1860, when the first oil fields were opened, Oil City and Franklin have been noted for the production of oil field equipment. This district supplied much of the equipment needed for early petroleum work in the Midcontinent fields. The peak year, with 4,500 wage earners, was in 1922. By 1935 the number had declined to less than 2,000. Many of the plants were closed or were operating

FIGURE 9.—The plant of the Allegheny Ludlum Corporation at Brackenridge.

at low capacity. The oil field supply companies were rapidly moving their plants to the major producing centers of the mid-west and west. The area still has a considerable body of skilled workers so that under the influence of war needs many of the plants are producing essential supplies. In 1942 there were more than 3,000 wage earners in the metal industries. In Venango County metal products, totaling $16,201,400 in 1942, were second in value of manufactured goods. In Warren County the production of metal products is centered in Warren where oil field supplies are most important but also automobile parts, axles, and metal furniture are produced in plants that employ from 10 to 500 workers. North of Warren the valley supports no large towns and little manufacturing is found.

The modern aluminum industry owes its development to Charles Hall who in 1886 discovered the electrolytic process of extracting the metal from bauxite. In 1888 he came to Pittsburgh in search of financial backing and obtained a limited sum for the erection of a small plant. The first plant was erected in Pittsburgh, but it was only a few months before it was moved to New Kensington. The initial output of aluminum was 30 pounds a day selling for about $8.00 a pound. Before 1886 aluminum, one of the rarest and most valuable metals, was used only to make jewelry and tableware. After aluminum was produced commercially a market for the new metal had to be developed so the producers turned to kitchen utensils, tubing, and metal sheets. Aluminum decreased in price as its production and uses increased.

At the time the aluminum industry was founded, the securing of capital was most important in establishing its location. As long as the industry remained small the bauxite ore could be shipped from Arkansas and there was sufficient electrical power for its conversion into metal. However, as production increased more ore was needed and greater quantities of electricity were used so the industry is installing its new operations outside the district in such places as Massena, New York and Alcoa, Tennessee where cheap water power is available. No longer is ore converted to metal in New Kensington and the plant is entirely a fabricating unit. In the Allegheny Valley the industry had its greatest growth from 1920 to 1930. Even at this time the national growth was greater than that of the local. Although the local growth has fallen far behind the national, the aluminum industry has exercised a stimulating influence on manufacturing activity in the district. Much of the future growth of the industry will take place outside this region, although there is no apparent reason for the aluminum industry to leave the area. Since the beginning of World War II the plant has been increased considerably and more workers are employed than at any previous period of its history.

THE GLASS INDUSTRY

The manufacture of glass products is one of the oldest industries of the Pittsburgh district. The first glass furnace was erected in Pittsburgh in 1798 and before 1830 several glass plants were constructed along the Lower Allegheny. The natural resources of Pittsburgh and its vicinity offered unusual advantages for the development of this infant industry. The abundance of glass sand and wood for charcoal as the first fuel, and later coal on the Monongahela River resulted in the centering of the glass industry along this valley. An important glass industry did not develop along the

Allegheny until natural gas became the principal furnace fuel. The discovery of natural gas permitted the glass industry to spread throughout the region. Plate glass, window glass, tableware, decorative glass, bottles, and jars are manufactured. Of these, plate glass is of primary importance.

The plate glass industry was late to develop in this country. Although the first rolled plate glass was made in 1688 at Saint Gobain in France, it was not until 1881 that the first plate glass factory was erected in the United States at Creighton, Pennsylvania. The industry was successful and the Allegheny Valley became one of the major centers of production (Figure 10). The Pittsburgh Plate Glass Company with plants at Creighton and Ford City has a breadth of operation comparable to some of the large steel companies. Their annual production is more than 60,000,000 square feet of plate glass and 1,200,000 boxes of window glass. These two plants produce over 90 per cent of the plate glass output of Pennsylvania. Within recent years as the natural gas resources are exhausted the industry has migrated westward and the national growth was much greater than locally. The total proportion of plate glass output for the valley decreased from about 60 per cent for the entire country in 1928 to approximately 33 per cent in 1940. After the outbreak of war in 1941, with building restrictions and ban on the manufacture of automobiles, the demand for plate glass decreased sharply and the manufacturers turned to the production of safety glass and plastics for military purposes.

The remaining plants of the valley are small but are important to supply local employment for 20 to 300 workers. Hollow glass ware is produced in Sharpsburg, Parkers Landing, Oil City, and Port Allegheny. There is one plant producing window glass in Arnold, and in Port Allegheny, a second plant, a subsidiary of the Corning Glass Company, produces specialty products. For the immediate future the relative position of the glass industry of the Allegheny Valley is likely to remain about the same. The glass plants had their greatest growth during the early part of the present century. The employment curve has gradually smoothed indicating the stage of economic maturity. Even though locally the glass industry does not grow as rapidly as nationally its contribution to gains in industrial output will be important.

PETROLEUM REFINING

During the two decades prior to the Civil War scientific interest was aroused in the study of illuminants and lubricants. Whale oil, beeswax, and tallow candles had been used extensively for illumination, and lard oil for greasing purposes, but with the decline of the whale fisheries and an inadequate supply of lard oil, the shortage of oil became acute. In 1846 a Canadian geologist produced in the United States the first illuminating oil from coal. This was the beginning of the coal oil or kerosene industry which had its greatest development in the 1850's. In 1859 there were six such refineries in the Pittsburgh district, the largest of all perhaps being

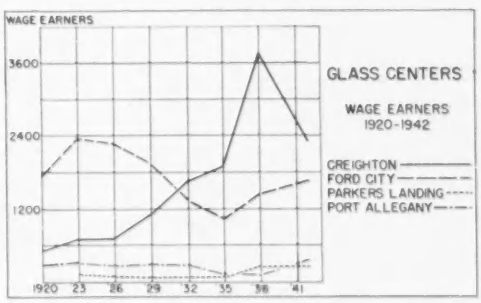

FIGURE 10.—Wage earners of selected glass centers.

that of the Lucesco Company at Kiskiminetas. Its distilling capacity was reported to be 6,000 gallons per day. The discovery of oil in 1859 caused the decline of these plants for they could not compete with the less expensive and better quality petroleum products.

Almost simultaneously with the rise of the coal oil industry, petroleum was placed on the market as an illuminating agent. Soon after the beginning of the nineteenth century petroleum began to appear in the salt wells of Pennsylvania, Ohio, West Virginia, and Kentucky. It was an impurity which was not welcomed and in most places allowed to escape. About 1849 the owner of the Tarentum salt wells saw the possibility of bottling the crude oil and selling it as a medicine under the heading, "Kier's Petroleum or Rock Oil." It gained some popularity, but Kier concluded that additional efforts would lead to more general utilization. He had the oil analyzed, and was told the oil could be refined profitably. The first petroleum still was erected in 1853 along the Allegheny north of Pittsburgh. The refinery was enlarged a number of times until 1858, which was probably the peak year for the refining of Tarentum crude, when 1,008 barrels were produced. Petroleum refining was well established along the Lower Allegheny when the oil fields were developed near Titusville, thus the Pittsburgh district remained the leading refining center until 1875. At its height in 1867 there were 58 refineries along the river bank. With the coming of the pipe lines the refineries were located with respect to the demand for finished products rather than with reference to the supply of raw materials. To the Lower Allegheny were left only enough operations to supply local demands.

In the Oil Region proper there were many refineries but they were small and relatively unimportant. There was a limited market for petroleum in the region and it was safer to transport the crude oil than the highly inflammable refined products. In 1893 the first refined pipe line was constructed from the Oil Region to the eastern coast. This was the first important impetus for the construction of large refineries in the oil district. A number of refineries developed in the next decade in Emlenton, Franklin, Oil City, Warren, Bradford, and Olean (Figure 11). The refining of Pennsylvania crude oil has passed through three periods. During the nineteenth century illuminating oils had the greatest demand so refiners produced a greater percentage of this product than any other. With the introduction of the automobile with its combustion engine at the turn of the century a market was created for gasoline. It was soon found that Pennsylvania grade oil yielded a large quantity of this product. With the growth of the automobile industry and the introduction of anti-knock gasoline made from western oils, Pennsylvania fuels could no longer supply the market demands. The quality of Pennsylvania lubricating oils has never been questioned so with the decline of the gasoline market in the early 1920's the refiners of Pennsylvania crude turned to this

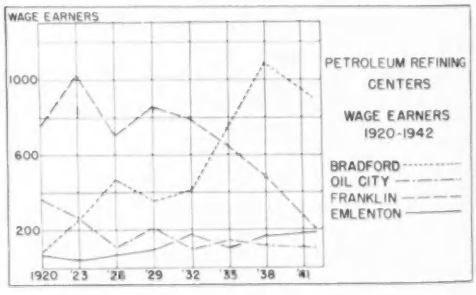

FIGURE 11.—Wage earners in petroleum refining centers.

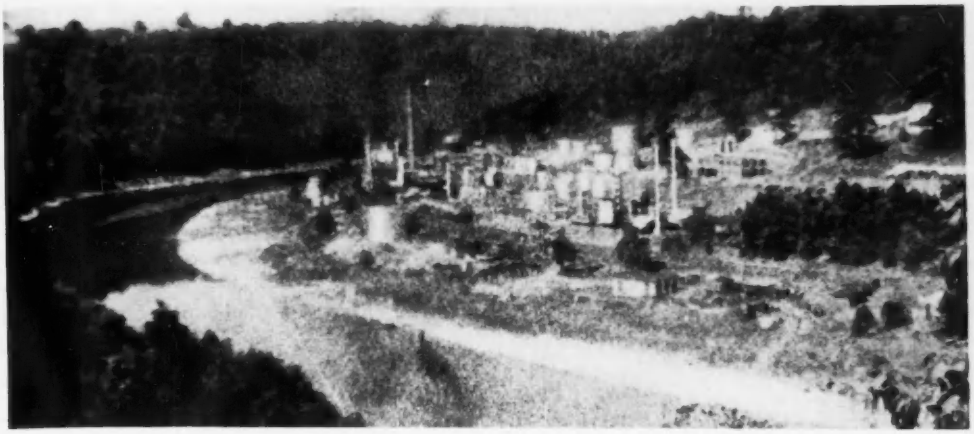

FIGURE 12.—The Quaker State Refinery located on the river bank at Emlenton.

product. Today it is the basis of the industry.

The refineries form a conspicuous part of the landscape of the modern oil towns (Figure 12). They are usually located on the edge of the urban areas because of the large space needed for plant installations, disagreeable odors, and fire and explosive hazards. The refineries with their tank farms, stills, tall rectifying towers, and smoke stacks present a distinctive picture. The refining of petroleum is an important economic activity in the northern Allegheny Basin. In 1942 the value of petroleum products in McKean County was twice that of all other manufactured goods. Since 1930 there have been two noticeable trends in the refining of petroleum in the Allegheny region. There has been a consolidation of refineries so that a few large refineries dominate the industry. In the Middle District since the supply of oil is limited a number of large refineries have migrated to the western oil fields. Between Franklin and Oil City is found the gutted environment of one of the wrecked plants (Figure 13). Everything of value has been removed leaving only the useless brick walls and towers. Such a deserted factory illustrates the final stage of an industry based on the exploitation of an exhaustible resource.

CONCLUSION

The industrial progress of the Allegheny Valley has not been uniform. The early development began with the timber, iron ore, and petroleum in the central and northern portion of the region. The development of these resources reached their zenith in the latter part of the nineteenth century. From 1850 to 1890 the modern industries were firmly established along the Lower Allegheny. There have been no new important industries established in the past forty years. The most significant stimulus to economic growth in the area since 1920 has been the expansion of the aluminum industry. Although the development of this industry slowed considerably during the depression years of the 1930's the local rate of increase is high in comparison with the rate of older industries. A more recent event of considerable bearing on the economic future of the area is the development of steel alloys. The expansion of this branch of the steel industry gives promise of making a real contribution to the Lower Alle-

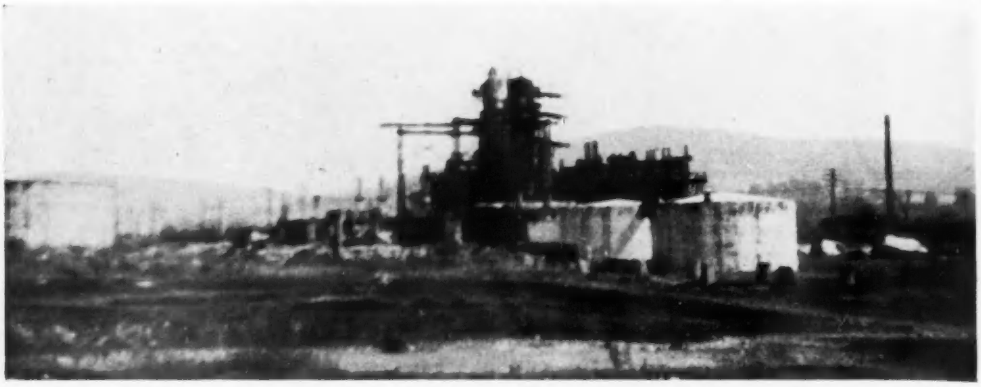

FIGURE 13.—The landscape of an abandoned petroleum refinery between Franklin and Oil City.

gheny. Of the natural resources, coal will continue to be most important in the lower portion and will increase in output as the coal beds of southwestern Pennsylvania are depleted, while in the northern portion petroleum will be of primary importance. The present war activities have attracted few plants, but the older plants have greatly expanded. Because of its natural resources, capital investments and skilled labor, the Allegheny Valley will continue to be a part of the industrial region of western Pennsylvania.

OUR MIDDLE AMERICAN TRADE

S. T. Emory

THE United States has in Middle America a tropical trade area comparable to only the very greatest imperial holdings and a developed tropical trade, built without restraint or compulsion on sound geographic bases, that exceeds the trade of the greatest imperial possessions with their respective home countries. Yet, we are as a people, largely unaware of our good fortune in having such a trade area and such a trade and are disposed to shrug off Middle American commerce as "banana business," particularly when compared with the commerce of India and the East Indies. To the general public "the wealth of the Indies" still represents the very acme of tropical riches, and the wealth of Middle America is still an unknown quantity.

The fact is, however, that the United States in a normal year does more business with the twelve, free Latin American countries bordering on the Caribbean Sea and the Gulf of Mexico than the United Kingdom does with India or the Netherlands with the Netherlands East Indies. The *total* foreign trade of the twelve Middle American countries has been for the past decade about equivalent to that of India and far larger than that of the Netherlands East Indies, and the Middle American countries have given the United States a larger percentage of their foreign trade, both in imports and in exports, than either of the great imperial possessions referred to has given its home country. It seems very probable, moreover, that both the volume of Middle American foreign trade and the percentage of it given to the United States could be considerably increased and is likely to be so increased in the near future; for the present war has taught us sharply that Middle America is a safer and more convenient source of tropical supplies than some of the trans-oceanic areas upon which we have depended.

It is not surprising, perhaps, that we have taken our great prize in world trade very much for granted—that, aside from the Panama Canal and defense bases, the general public thinks of the Caribbean region mainly in terms of bananas and revolutions and that even the well-informed student is likely to undervalue our Middle American trade. The reading public has been exposed for decades to the stories of "O. Henry" and his successors; stories which depict Caribbean business as well as Caribbean wars in a semi-comic vein. Most of us read stories more readily than we do trade statistics, so it is not very surprising that the public is inclined to dismiss Middle American commerce as something colorful and romantic but hardly to be taken seriously by a business man. Even the student is handicapped in that Middle American trade statistics are usually presented separately for each of the twelve nations involved or, occasionally, in compilations covering all Latin America. In the separate reports Mexico, Cuba, Venezuela, and Colombia stand out as important trading nations, but the Middle American entity does not appear. In totals for all Latin America,

Middle America disappears in the large and diverse economy of this very large and diverse area.

It would seem worth while to present a compilation of trade statistics for the Middle American area and to consider Middle America as a trade unit, particularly at this time, when far-flung battle fronts and critical issues in far places tend to divert our attention from peaceful things and from near-by places. In the global peace to follow this global war the United States should never for an instant forget Middle America—far more vital to the welfare of the United States than most of the areas that now focus our attention. It would seem worth while, too, to present Middle American statistics in comparison with similar figures for India and the Netherlands East Indies, since large sums of money are hard to comprehend and since India and the Netherlands East Indies are popularly accepted as offering a criterion for the appraisal of tropical wealth.

Middle America will be taken here, somewhat arbitrarily, as the twelve independent Latin-American countries bordering the Caribbean Sea and the Gulf of Mexico—plus Salvador. Possessions of outside powers, such as Puerto Rico and Jamaica, are not included: Middle America as here presented is made up of free, independent countries, under no constraint as to the origin of their imports or the destination of their exports. India and the Netherlands East Indies will be taken as defined in *Foreign Commerce Yearbook*, and statistics presented will be taken or compiled from the 1933, 1936, and 1939 editions of this publication. Minor qualifications of these statistics will not be noted; the assumption being that statistics presented in *Foreign Commerce Yearbook*, though incomplete in some details, represent the best information available, and that minor imperfections do not materially affect the composite figures. It should be noted, however, that absolutely accurate totals are very difficult to obtain, since variations in fiscal year, revision of statistics in succeeding years, and omission of statistics for some of the small trading nations for certain years make it necessary at times to decide arbitrarily between two sets of figures. It should be noted, too, that India includes Burma up to April 1, 1937. It seems unlikely, however, that separation of Burma from India will make any great difference in India's foreign trade. Approximately half of Burma's foreign trade is with India and half with other overseas countries. The half of Burma's foreign trade that goes to India will be added to India's trade totals, since it was formerly domestic trade. On the other hand, the other half of Burma's trade will be lost to India, since it was formerly included in India's foreign trade totals. The net result should be a very small difference in Indian totals. It may be wise to repeat that statistics given here are approximate only, and that they can be checked only against the particular table from which they were taken. They are, however, approximately accurate—accurate enough to substantiate the conclusions drawn from them.

BILLION DOLLAR BUSINESS

The total foreign trade of Middle America places it in the very forefront of great tropical commercial areas. Five-year averages of combined imports and exports for the twelve nations run in the neighborhood of a billion and a half gold dollars for the fifteen years from 1916 to 1930, having more than doubled the totals for the decade prior to the first World War (Table I). India ran far higher in the pre-World War years, but only from eight to seventeen per cent

higher during the 1916–1930 period. Middle American foreign trade far exceeds that of the Netherlands East Indies throughout the thirty-year span of Table I.

TABLE I

VALUE OF COMBINED IMPORTS AND EXPORTS OF MIDDLE AMERICA, INDIA, AND NETHERLANDS EAST INDIES

(Five-year averages, millions of gold dollars)

Years	*Middle America*	*India*[1]	*Neth. East Indies*
1906–10	531	971	257
1911–15	643	1,183	399
1916–20	1,497	1,626	769
1921–25	1,491	1,790	826
1926–30	1,655	1,904	958
1931–35	658	698	359

[1] Re-exports and shipments of currency not included.

The trade of all three areas crashed disastrously during the depression period of 1931–1935, but Middle America more than held its own in relative position, averaging some six per cent below India for this period.

Annual totals for the ten years 1929–38 show the twelve Latin-American countries are almost equal to India in foreign trade, while the Netherlands East Indies are far outdistanced by both (Table II). Indian trade exceeds that of Middle America during the first seven years of this decade, but the percentage of India's excess drops steadily from sixteen per cent in 1929 to six per cent in 1934. Middle America and India are almost equal in foreign trade in 1935, and Middle America leads for the remaining three years of the decade. India's average excess for the ten years is some seventy-one million dollars—no great margin, considering the magnitude of the trade. The Netherlands East Indies run consistently at about half of the Indian total and far behind the totals for Middle America.

Statistics for years subsequent to 1938 are of doubtful value in showing general peacetime trends. Figures for 1939 are available, but it would seem that abnormalities of war trade and dislocations due to war render this and subsequent years useless for purposes of comparison. It seems fair to say that for the last decade before the outbreak of the present war the total foreign trade of Middle America was about equivalent to that of India and far larger than that of the Netherlands East Indies.

TABLE II

VALUE OF COMBINED IMPORTS AND EXPORTS OF MIDDLE AMERICA, INDIA, AND NETHERLANDS INDIES, 1929–38

(Annual values, in thousands of gold dollars)

Calendar Year	*Middle America*	*India*[1]	*Neth. Indies*
1929	1,734	2,064	1,002
1930	1,338	1,575	797
1931	913	1,011	518
1932	628	707	364
1933	533	648	315
1934	584	620	310
1935	637	642	288
1936	691	676	310
1937	865	810	468
1938	752	682	369

[1] Shipments of treasure and re-exports omitted.

CONCENTRATION OF TRADE

The most impressive phase of Middle American trade is not, however, the totals of *all* foreign trade, impressive though they are: it is the percentage of that trade concentrated in the United States, and the resulting volume of trade between the United States and Middle America. Particularly is this concentration impressive when compared, either as to percentage or as to total value, with the trade between India and the United Kingdom or the Netherlands East Indies and the Netherlands.

Annual values in gold dollars for the years 1929–38 (Table III) show the trade between the United States and the Middle American countries running

over fifty per cent greater than the trade between India and the United Kingdom and some two hundred to three hundred per cent greater than that between the Netherlands East Indies and the Netherlands.

TABLE III

TRADE BETWEEN SPECIFIED AREAS, 1929–38

(*Millions of gold dollars*)[1]

Year	*Middle America —United States*	*India—United Kingdom*	*Neth. E. Indies —Netherlands*
1929	988	633	178
1930	722	475	138
1931	521	311	92
1932	340	226	65
1933	256	226	51
1934	278	227	57
1935	334	222	58
1936	363	242	66
1937	461	259	92
1938	385	223	78

[1] Combined imports and exports. Figures derived by taking proper percentage of total foreign trade.

The percentage of Middle American foreign trade that flows to and from the United States is astonishing, particularly when the trade of these independent countries is compared with that of colonial India and Netherlands East Indies. Colombia during the 1929–38 period took an average 43.6 per cent of her imports from the United States. Cuba during the same period took 59.9 per cent of her imports from the United States; Mexico, 63.7 per cent; and Venezuela, 49.5 per cent. These are the four large importers of Middle America, and nearly all the smaller countries show similar percentages. In comparison, during the same period, India took 37.5 per cent of her imports from the United Kingdom, and the Netherlands East Indies took only 16.8 per cent of its imports from the Netherlands.

In the same ten years Colombia sent 69.1 per cent of her exports to the United States; Cuba sent 75 per cent of her exports to the United States; Mexico sent 57.2 per cent; and Venezuela, 18.6 per cent. In comparison, India during this period sent 29 per cent of her exports to the United Kingdom, and the Netherlands East Indies sent 19.6 per cent of their exports to the Netherlands. The low Venezuelan export to the United States is explained by the fact that the principal export, petroleum, goes mainly to the Dutch islands of Curacao and Aruba for refining and is counted as an export to these islands. As a matter of fact, most of it goes eventually to countries other than the United States, for we produce most of our requirement in petroleum. Venezuela's second export, a mild brand of coffee, goes largely to European markets. Some of the small traders not specifically listed here trade heavily with certain European countries. On the whole, however, their trade shows much the same pattern as that of Colombia, Cuba, and Mexico, and the United States enjoys the lion's share of Middle American trade, both imports and exports. For example, in 1937, a reasonably representative year, the twelve Middle American countries took 57.7 per cent of their total imports from the United States and sent 49.9 per cent of their total exports to the United States.

IDEAL TRADE PARTNERS

Much of the explanation of the astonishing trade between Middle America and the United States lies in the fact that these two areas are geographically almost ideal trade partners—more nearly so than the two European countries and their respective colonies are. One great geographic advantage is in simple distance. The Caribbean countries are either contiguous to the United States or they are connected with the United States, rather than separated from it, by a short sea journey. Compare the Caribbean distances with those

between England or the Netherlands and their colonial ports (Table IV). The advantage is obvious. In fact, no other great industrial country, save perhaps Japan, is so conveniently located with reference to a great tropical producing area as is the United States with reference to Middle America.

TABLE IV

DISTANCES BETWEEN SELECTED PORTS

(*Nautical miles*)

Colon to New York	1,974
Colon to New Orleans	1,399
Havana to New York	1,186
Havana to New Orleans	603
Southampton to Bombay, via Suez	6,090
London to Singapore, via Suez	8,297
Liverpool to Singapore, via Good Hope	13,458

Another great advantage is that the United States and the twelve Caribbean nations are better matched as trade partners than are the other two partnerships concerned. All three of the northern nations are commercial and manufacturing countries with the same general type of civilization and the same general type of requirements from tropical trade, but their requirements vary in detail and in scale. The three tropical areas have the same types of climate, Middle America duplicating in some part of its territory all the climates of India and the Netherlands East Indies. Middle America and India are not much different in area; Middle America is about one sixth larger than India. The Netherlands East Indies have about half the area of Middle America. All three tropical areas have a varied topography of plains, plateaus, and mountain ranges, and all three have their best soils in volcanic or alluvial deposits limited in extent, or in small limestone plains. There is a general similarity of pattern in the three areas, but the percentage of area in the several climatic regions, in the several topographic provinces, and with certain types of soil varies greatly. Population density varies, mineral wealth varies, and economic development varies. Thus there is room for wide divergence in tropical production, just as there is room for great divergence in demands of the middle latitude nations. The result thus far is that the three patterns of trade between the paired middle latitude and tropical areas are similar, but that details and quantity vary. Further consideration will show that the trade partnership between the United States and Middle America is the best balanced of the three and that the traditional pattern of trade between a great middle latitude country and a great tropical producer is more plainly evident here than in the other two trades.

Although there is a tremendous trade between them, India and the United Kingdom are unable in very high degree either to satisfy each other's needs or to consume each other's surplus production. India is a great and densely populated tropical country, and the United Kingdom is a great and densely populated middle latitude country. Both are industrialized—the United Kingdom highly so, and India much less intensively. Both need to import large quantities of food, petroleum, and raw materials for manufacture. Neither is able to supply these demands of the other fully, though India does contribute large exports of cotton, jute, and wheat to the world market, as well as hides, skins, and vegetable oils. Indian wheat and cotton are not sufficient for the needs of the United Kingdom, and India itself imports cotton, rice, and petroleum, none of which can be supplied by the United Kingdom from its own resources. On the other hand, the United Kingdom cannot consume India's jute. Further, India manufactures cotton goods and jute products on a large

scale and exports them in quantity, rather than sending all the raw materials to the United Kingdom for manufacture and importing the finished product. The same is true of minerals. India exports considerable quantities of minerals and imports considerable quantities of mineral manufactures, which, of course, the United Kingdom is ready to supply. However, India has a considerable minerals industry of its own and competes with some British manufactures for the Indian, and to some extent the world, market. India is too densely populated and industrially too well developed to be an ideal trade partner for such a great, densely populated, industrial country as the United Kingdom. Thus, though there is a vast trade between the two countries and though this trade shows the accepted pattern of raw materials flowing to the British Isles and manufactured goods flowing back to India, it is still not an ideal trade partnership because the reciprocal needs of the two countries are not well enough balanced to allow either country to supply to a very high degree the fundamental needs of the other.

Turning to the Netherlands and the Netherlands East Indies, we find the tropical area too productive for a balanced trade with its home country. The Netherlands is a small, commercial and agricultural country, to some degree industrialized. It can absorb in its own consumption and in manufacture for foreign markets only a small part of the enormous production of its East Indian islands. The Netherlands is insufficient as a market for its colonies: only tin, among the great exports of the Netherlands East Indies, is imported by the Netherlands in approximately

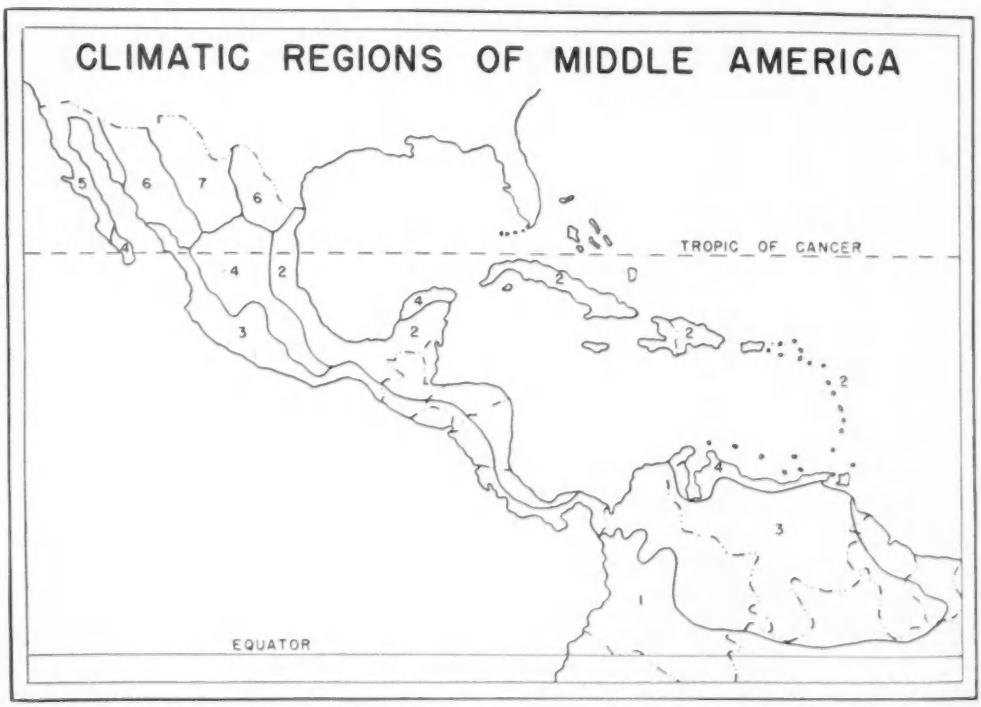

FIGURE 1.—(Modified from Koeppe) 1, Wet Equatorial; 2, Trade Wind Littoral containing some areas of Wet Equatorial climate; 3, Wet and Dry Tropical; 4, Semi-arid Tropical; 5, Tropical Desert; 6, Semi-arid Continental; 7, Intermediate Desert. Note that various Mountain Climates are included in the Wet Equatorial area of Colombia.

the quantity exported by the Netherlands East Indies. On the other hand, the Netherlands East Indies, particularly Java, need to import food, and, though they are developing industries, they still need to import large supplies of iron and steel, machinery, and cotton goods. In no one of these categories is the total Netherlands export equal to the total East Indies import. Either as a consumer or as a producer, therefore, the Netherlands is too small for a balanced partnership with its great East Indian islands.

The twelve Middle American nations, on the other hand, are a great, thinly populated tropical area still producing and exporting tropical foods and raw materials and buying manufactured goods and middle latitude foods. They are paired in the Caribbean trade with a great industrial nation and a great producer of middle latitude foods. With the one exception of petroleum, the United States is capable of absorbing practically the full present production of Middle America, both mineral and vegetable, and of absorbing a greatly increased production in many items. Middle America is unable to absorb all of the United States surplus in middle latitude foods and in manufactured goods, but it is able to supply practically all its needs, both in variety

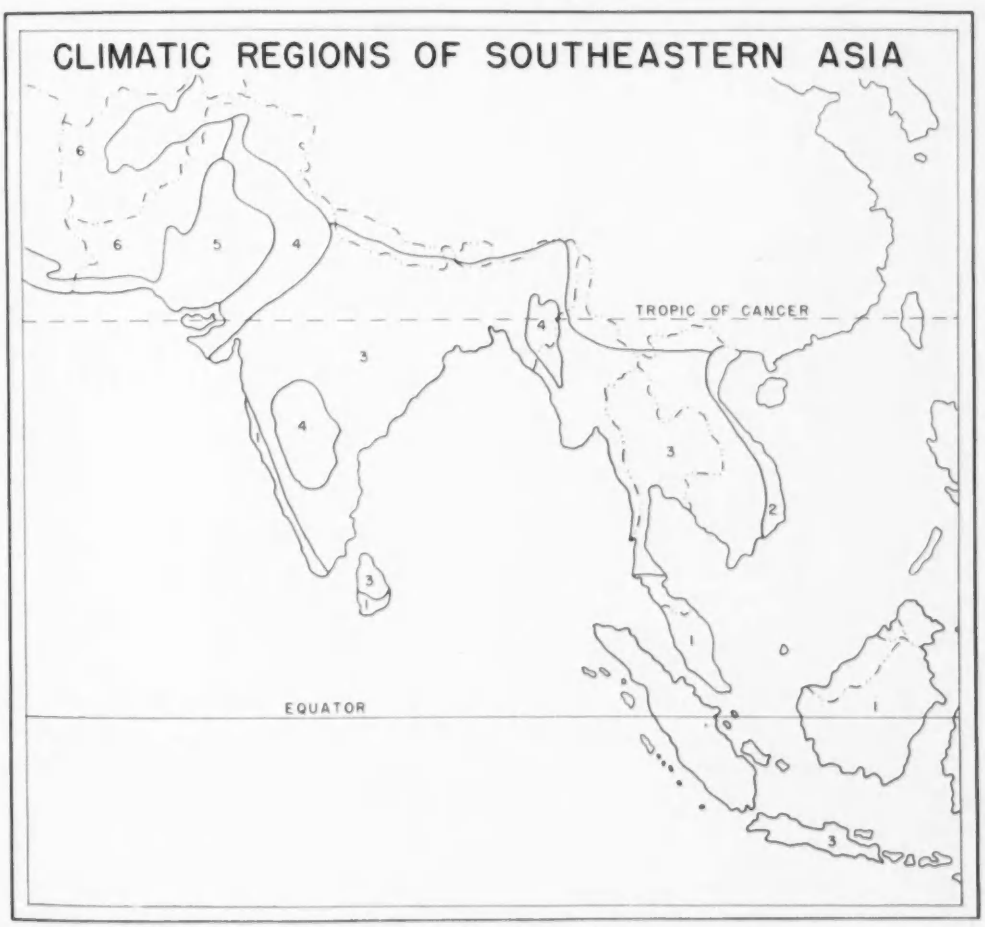

FIGURE 2.—(Modified from Koeppe) Climatic regions as in Figure 1. The two maps are drawn on the same scale.

and in quantity, from the United States. Thus, there is a high degree of reciprocity betewen the two partners in the Caribbean trade, and a relatively ideal balance that enables the two areas to a high degree to satisfy each other's needs for overseas produce.

THE NATURE OF THE TRADE

The United States takes a major share of nine of the first ten Middle American exports, the exception being petroleum and petroleum products. Middle American imports are largely met, and could be almost wholly met, by the United States. The Caribbean countries supply a large part of two of the major imports of the United States and seem potentially capable of supplying a large part of two more. They furnish, too, varying percentages of a long list of lesser items imported by the United States, and once more seem capable of supplying more.

Minerals have a high place in Middle American exports. Petroleum has first place; gold and silver, if taken together, have fourth place; lead stands fifth; zinc is seventh; and copper and copper ores are tenth—all ranked according to value. These minerals are of interest in their present level of production, for they supplement our own great resources, and they are of interest in that it is generally believed that their production could be greatly increased. The Caribbean area is highly mineralized, and it has not been intensively prospected until recently, nor have all known possibilities been fully developed. It seems likely that this area cannot only supplement our current production, but that it offers a reserve for a time when our needs are greater.

A number of minerals used in lesser quantity, but of great importance to the United States, occur in Middle America. It is worth while to consider these minerals, using as a base for the discussion *Latin America as a Source of Strategic and Other Essential Materials*, published in 1941 by the United States Tariff Commission. It should be noted that there has been a considerable war-inspired activity in this field since the publication of the booklet referred to. The reference is, then, a conservative one. This publication credits Mexico with supplying about two-thirds of United States imports of antimony and amorphous graphite and about ten per cent of the world's vanadium, as well as small amounts of tin and tungsten. Mexico is the world's fourth producer of mercury, and an exporter of cadmium, molybdenum, arsenic, and asphalt. Colombia supplies about ten per cent of the world's platinum, and is a producer of gold and emeralds. Cuba exports iron ore and a little manganese and asphalt. Venezuela has, in addition to its petroleum, a great undeveloped deposit of iron ore and some gold and diamonds. Exploration and development is being pushed actively throughout Middle America, and, while full information as to the results is not available, it seems likely that the mineral production of the area will be increased, both in quantity and in variety, if the needs of the commercial world justify it and particularly if the United States continues to interest itself, when the present emergency is over, in promoting production in this near-by and safe source of needed minerals.

The United States and Middle America are well synchronized in the production of the vegetable world. Cane sugar, second Middle American export in value, and coffee, third export in value, are among the first ten imports of the United States. Further, the United States is the chief market for the banana, sixth in value among Middle American exports; for molasses, eighth

in value; and for tobacco, ninth in value. In addition to these principal exports, there is a long list of minor exports, some of them produced in small quantity in Middle America though needed in large quantities by the United States.

POTENTIAL PLANTATION PRODUCTION

There seems to be a possibility of developing plantation production in Middle America of a number of commodities heretofore supplied us from other areas. At present the Dominican Republic, Venezuela, and Panama supply us a part of our cacao requirement, but we take about half our requirement from Africa and most of the rest from Brazil. We use about a third of the world's cacao, and there seems to be no doubt that a large share of our demand could be furnished by Middle America. We import cinchona bark, in normal times, from the western Pacific. Yet, Colombia, Guatemala, and Nicaragua grow small quantities of the bark. Both cacao and cinchona are native to this part of the world, and there is every reason to believe that production in Middle America could be increased. Henequen is supplied to the United States mainly by Mexico, with Cuba as a minor producer, and production could be increased if necessary. Panama has a small production of abaca, or Manila hemp, but our chief source of supply has been the Philippines. Again, there seems to be no insuperable difficulty in developing a supply in Middle America. Five Middle American countries grow small quantities of castor beans and kapok—and seem capable of greater production. Cocoanuts grow widely along the Caribbean, and a large production of copra and cocoanut oil seems possible. Palm oil seems a possibility. Though the oil palm is not native, there are considerable areas with essentially the environment in which the African oil palm thrives. Perhaps the most interesting possibility of all, however, is production in Middle America of rubber and either jute or a substitute for jute. Experimental plantings of rubber trees have been made on the Middle American east coast, and the guayule shrub, native to Mexico, has been subjected to experimental production during the past two years. As to jute, it seems possible to duplicate the conditions under which jute grows in India or to develop one of several native fiber plants as a substitute for jute.

In plantation development, save in the case of the banana, the United States has stopped short of full support of Middle America. We have long given Cuba a preferential tariff rate on sugar

FIGURE 3.—Seedling rubber trees. The man is over six feet tall. (Courtesy of Public Relations Department, Goodyear Tire and Rubber Company.)

and our Puerto Rican sugar has, of course, entered the United States duty-free. However, even in the sugar business, we have developed plantations in the Philippines and have admitted Philippine sugar free of duty, this building up—admittedly with good reason—an overseas supply of the product. We have been buying about one-third of our coffee from Middle America, but we have bought the major share from Brazil. Much of our cacao, as has been stated, and virtually all of our cinchona bark, copra, cocoanut oil, and palm oil has come from trans-oceanic sources—from the Netherlands East Indies, the Philippines, and West Africa. We have been content to buy jute from India, and rubber from the Netherlands East Indies and the Malay Peninsula until recently, and even in recent developments one of the great, new rubber plantings is in Liberia and one in the Amazon Valley. The present war has brought it sharply home to us that distant sources of supply are not dependable in time of war. It is to be hoped that we shall not forget our lesson, but that we shall continue in Middle America a planned, government-supported development of varied plantations on a large scale. Such a development would recognize and exploit the fact that this area is of first importance to the United States, not merely for its convenience but possibly for its actual survival as a nation.

FIGURE 4.—Stocks budded with noble strains of the rubber tree. (Courtesy of Public Relations Department, Goodyear Tire and Rubber Company.)

There are many difficulties in the way of such a development, but only such difficulties as have been met in almost all tropical developments. One is a scarcity of labor, though the Middle American countries have been liberal on the whole as to imported labor. An allied difficulty is the possibly high cost of Middle American plantation products, due to scarcity of labor. Such an increase of cost, it seems, might well be charged to the account of national security and be paid for, if necessary, by subsidy or by a preferential tariff. There are difficulties due to disease, such as the rubber wilt, but such difficulties are general in tropical plantations. A slow and costly process of experimentation will probably be necessary before the optimum strains of plants, the best sites for plantations, and proper methods of cultivation and processing are discovered or developed. Here again it would seem reasonable for the Government to underwrite the initial experimentation as one phase of national defense. Still another difficulty is the inertia of an established foreign trade and the complicated net of customs, agreements, and understandings that has grown up between us and our former sources of supply. There will, doubtless, be strong pressure brought to bear for a resumption of our trade with the Malay Peninsula and the Netherlands East Indies. Many considerations will operate toward a continuance of our dependence on India

and West Africa for jute, cacao, and palm oil. Sentiment will press strongly for a resumption of trade with the Philippines, regardless of their proposed independence. There will be strong reasons, economic, political, and emotional for continuing or resuming our trans-oceanic trade. There is danger that, once the present war is won, we shall dull our present sense of urgency and be content once more to rely upon distant sources of essential commodities. We should as a nation bear in mind the dangers and difficulties of trans-oceanic supply and keep in the foreground the strong economic, political, and sentimental reasons for fostering Middle American trade—for the Middle American neighbors have been loyal to us through two wars, and we have been able to reach them when customary sources have failed.

THE FACTOR OF SECURITY

Security is perhaps the most important value to be weighed in setting up our post-war commerce. We are quite aware of this value at present, but it may be worth while to consider Middle America at some length as to security, lest we forget this value in post-war settlements, and yield too easily to pressures for resuming former trade channels and areas of supply.

The security of this area lies not only in its proximity to the United States, already discussed, but in the political geography of Middle America itself and of Latin America in general. Consider Middle America and its neighbors. There is no single powerful enemy of the United States, actual or potential, closer to the Caribbean than Western Europe. Brazil is a great nation, but Brazil is traditionally friendly to the United States and, being herself a great tropical producer, is not envious of our trade with the Caribbean area. Further, most of the densely settled part of Brazil is cut off from Middle America by the tremendous barrier of the Amazon forest—and Rio de Janeiro is as far from the middle of Middle America as is Labrador! Argentina is farther away from Middle America than is Western Europe. No other nation in the Western Hemisphere, save Canada, has a war potential approaching that of the countries named, and it is hard to imagine a combination of countries in this hemisphere that would challenge the power of the United States. Compare India, closely neighbored by Russia and perhaps Japan, or the Netherlands East Indies, set within the reach of three great powers!

We are incomparably fortunate in our access routes to the Middle American tropics. Our good fortune is brought out in dramatic fashion by comparing our routes to the Caribbean countries with routes from Western Europe to India or the Netherlands East Indies. The Suez route from Western Europe to

FIGURE 5.—Seed garden area. The trees are three years old. (Courtesy of Public Relations Department, Goodyear Tire and Rubber Company.)

the East must pass along the coasts of France, Portugal, and Spain and then through the Gibraltar bottleneck between coasts held by Spain. Next it passes through waters vital to France and through the narrow waist of the Mediterranean, held by Italy to the north and France to the south, and through the eastern Mediterranean, crowded with conflicting national interests. Next there is the Suez Canal and the long journey through the Red Sea, with Mohammedan nations flanking the route and, until recently, French and Italian holdings along the coast. Finally, there is the Aden pass and the long journey through the Indian Ocean. To guard this route Britain has long held fortresses at Gibraltar, Malta, Cyprus, Haifa, Suez, and Aden, and has stood ready to fight in the Atlantic, the western or eastern Mediterranean, the Red Sea, and the Indian Ocean. The Netherlands depended on the good will of Britain for freedom to use this vital route. Yet, all Britain's great outlay of power proved insufficient—and the Suez route was promptly closed when the present war broke out. The alternate Cape of Good Hope route is extremely long—too long for secure convoying, and subject to danger until recently from several suspect foreign coasts.

FIGURE .—Trees between six and seven years old. Note the cover crop beneath the trees. (Courtesy of Public Relations Department, Goodyear Tire and Rubber Company.)

Turn to the Caribbean. Routes even from New York lie along our own coasts and through waters studded with our bases. Routes from the Gulf ports lie wholly within the guarded confines of the Gulf of Mexico and the Caribbean Sea, without a single enemy within the perimeter of United States bases and with an ocean between those bases and any nation with a war potential comparable to our own. It is true that even the staunch defenses of these friendly waters have proved insufficient against enemy submarines. Still, the enemy has been unable to close the routes, and it is hard to see how any enemy could long deny us access to the short routes through the Caribbean. It should not be forgotten, moreover, that we have an alternate route. We can reach ports of most of Middle America from our Pacific ports and through Pacific waters.

GOOD NEIGHBORHOOD VERSUS EMPIRE

We have, then, in the independent Caribbean nations, the equivalent in total trade of the richest imperial possessions, and more than their equivalent in the proportion of their trade that we enjoy. Potentially these nations are an even greater source of the commodities we need and an even greater market for the commodities we need to sell. This great, and potentially greater,

trade area is closer at hand than any comparable area is to any European nation, and routes between it and the United States are far safer than similar routes from Europe to the tropics. The great trade already developed between Middle America and the United States has been developed without full Governmental support. It is to be hoped that the United States will recognize officially, in the post-war world, the fact that the Caribbean area is one of peculiar and vital importance to us, not only as a strategic area, but as a source of supply and as a market. Such recognition should mean that we would continue and intensify our present efforts to foster Middle American trade. Reciprocal treaties of the pattern negotiated recently by the State Department could be pressed further and wartime Governmental expenditures for promoting production in Middle America could be continued where necessary into the post-war years. Any objection to such preferential treaties or to Governmental expenditures should be stilled by recalling the perilous straits to which we have been reduced, and the great Governmental expenditures necessitated, in the past several years by our reliance on overseas sources of supply. The nations around the Caribbean should not fear such a program. It is unthinkable that the United States should be tempted to conquest and empire in a region in which a policy of friendship has proved to be more satisfactory and more profitable. The only alternative to such a special development in Middle America would seem to be the abandonment of empire by all great powers and an agreement that all resources of all tropical areas shall be open on equal terms to all nations. So long as other great powers build and hold empires for their own profit and security, so long do we need jealously to develop and maintain our own particular Good Neighborhood—our substitute for empire.

THE TUNG REGION OF CHINA

Yen Chiang-kwoh

Introduction

CHINESE tung oil, also called "Chinese wood oil" in commerce, is obtained from seeds of trees of the Euphoribiaceae family. In China there are two principal species, namely, Aleurites fordii Hemsl. and A. montana Wils. Trees belonging to the former species grow abundantly in most parts of China. They are a fast growing tree, about twenty feet in height, with a strong trunk and many flat-topped branches covered with foliage and flowers. They usually come into their first flowering and bear little fruits during the third to fifth year after planting, yield a variable production thereafter according to age, and decline rapidly after twenty-five years. In the middle of September each year, fruits are collected from a fully matured tree; in each fruit there are three to five seeds with a hard shell and oleaginous kernel. The seed when dried contains 36 per cent oil, but the practical yield of oil by the primitive method used in rural areas amounts to only 24 to 31 per cent. This method consists of the following steps: seeds are roasted, ground into powder, the powder is put in a hollowed-out log, and pressure is applied with wedges on a movable partition. In this way the tung oil is expressed. A second pressing of the residue is generally made, from which a low-grade oil is obtained which is usually mixed with that of the first extraction.

Almost all Chinese tung oils are so obtained, although the modern hydraulic press is also utilized in a few tung oil producing centers. No complaints of poor quality have been heard since the Chinese government set up the Bureau for Testing and Inspection of Commercial Commodities to prevent tung oil from being adulterated with other lower priced oils. This oil is a thick- and at low temperatures, semi-solid substance, pale yellow to dark brown in color, possessing a somewhat unpleasant taste and strong characteristic odor. Since it consists chiefly of the glycerides of elaesteric, lenolic, and oleic acids, it possesses even more strongly pronounced drying power than linseed oil, forms a skin more rapidly than the latter, and therefore constitutes one of the vital materials for manufacturing industries.

In China the oil is used in preserving, polishing, and water-proofing wood, in making water-proof cloth, umbrella paper, and water-proofing bamboo netting, and as an ingredient of lacquer and paint. It is also used as lamp oil, and in the treatment of boils, ulcers, swellings, and burns. The cake obtained as a by-product in the preparation of tung oil is used as fertilizer or in the manufacture of lampblack. In foreign countries tung oil is widely used as a substitute for linseed oil, mainly in the manufacture of paint, varnish, enamel, oilcloth, linoleum, printing ink, electric insulating material, etc. It is also regarded as an effective insecticide capable of destroying insects which infest the roots of certain crops.

From the standpoint of world production China has much to boast of, claiming more than 95 per cent. She is the world's largest tung oil exporter. The volume of exportation showed an

upward trend during recent years. Especially since 1934, tung oil has taken the place of tea as a leading export commodity and plays a vital part in her national economy. In 1937, which is generally considered the last year of export prosperity, the total quantity of tung oil exported from China, as shown by the Chinese Customs Trade Report, reached 1,029,789 quintals, of which over 60 per cent was taken by the United States, 20 per cent by Hongkong, and 4.55, 3.61, 3.58 and 9.37 per cent by Germany, France, Great Britain, and other countries respectively. The total value amounted to $89,845,563 (Chinese currency) representing 10.72 per cent of China's total export trade for that year. During the last few years, China's volume of export showed a substantial decline due largely to transport difficulties. A new market has, however, merged at home. A large part of the production is now used for "cracking" gasoline, and a smaller quantity used directly as fuel for motor cars specially fitted for the purpose.

oil production in China. This brief article is prepared chiefly to present the existing situation on this subject. An analysis of the several factors that have operated in the concentration of tung trees is also discussed here and may be of assistance to those who wish to make a further investigation of the subject or who are engaged in this industry.

DISTRIBUTION OF TUNG OIL PRODUCTION

China is known as the home of tung trees. Her historical records show that tung trees were growing as long ago as the early Tang dynasty. Nowadays, they grow extensively in the large area from longitude 100 degrees E. to 122 degrees E. and from latitude 22 degrees N. to 34 degrees N. This covers the whole or a part of the following fourteen provinces in the order of the amount of production: Szechwan, Hunan, Hupeh, Kwangsi, Chekiang, Kweichow, Shensi, Anhwei, Kiangsi, Honan, Fukien, Kwangtung, Sikang,

Year	*Total Quantity of Tung Oil Export from China (Quintals)*	*QUANTITY PERCENTAGE OF DISTRIBUTION AMONG THE MAIN COUNTRIES OF DESTINATION*					*Total Value of Tung Oil Export from China (Chinese $)*	*Value Percentage of China's Total Export*
		U.S.A.	*Hongkong*	*Germany*	*Great Britain*	*France*		
1913	280,409	67.13	6.08	7.40	6.22	1.72	6,002,254	0.95
1923	506,141	70.93	13.00	7.77	5.82	0.79	26,216,130	2.24
1933	754,081	70.51	8.99	1.90	6.08	2.98	30,261,269	4.94
1934	652,836	62.86	13.26	3.44	4.79	4.88	28,216,683	5.28
1935	738,865	66.58	11.83	3.92	4.95	4.22	41,582,879	7.22
1936	867,383	71.81	6.94	4.95	4.36	6.26	73,378,654	10.40
1937	1,029,789	62.27	20.62	4.55	3.58	3.61	89,845,563	10.72
1938	695,777	8.14	80.21	2.13	2.91	1.45	39,237,038	5.14
1939	335,016	2.08	87.75	0.85	1.86	0.62	33,614,794	3.39
1940	232,472	17.98	66.02	....	4.38	0.32	56,357,844	2.86
1941	205,778	30.75	52.05	1.37	2.13	....	93,870,717	3.64

(Based on the "Chinese Customs Trade Report," 1913–1941. Data for 1941 are the summation of the first ten months. Note that Hongkong, listed as a "country of destination" in the Report, was in the years between 1937 and December, 1941 the largest transshipping center of the Chinese tung oil for foreign countries, especially to U.S.A.)

While the high industrial value of tung oil is widely appreciated, perhaps only a few people have a clear idea of the geographical distribution of tung

and Yunnan. In view of the scattered and haphazard location of tung tree plantations over the mountainous regions, accurate figures for the present

acreage are impossible but, according to the reports compiled by the Department of Research of the Foreign Trade Commission of China, it is estimated at about 1.5 million acres. As the majority of the producing provinces have not yet been greatly affected by the present war and the size of tung acreage is much more stable than that of other agricultural crops in China, China's tung oil production for the current year is expected to be about the same as for normal years, namely 1,360,000 quintals. This figure is available, as the export data reveal that the shipments abroad in 1937 amounted to about one million quintals and the domestic consumption of that year was probably 360,000 quintals. Over 85 per cent of the total production is contributed by the first four provinces and Kweichow, all situated in the Southwest to form the tung oil producing center of China. The other provinces produce comparatively little except Chekiang which, because of increase in acreage during the past five or six years, is now producing much more than during the past decade.

Taking the provinces into consideration individually, Szechwan is the largest tung oil producer in China, being responsible for 450,000 quintals or nearly one-third of the total production of the country in a normal year, according to information gathered by the Department of Research of the Foreign Trade Commission. About 350,000 quintals are exported abroad while the rest is consumed locally for illuminating or other purposes. In Szechwan tung groves are mainly centered in the eastern part, to a less extent in the northern and southern sections, and rarely in the western areas. The province may be divided into three zones, namely, the Chwan River, the Chialing River, and the Wu River zones according to the natural tendency of distribution. The Chwan River zone produces annually about 230,000 quintals, of which the greater part is assembled in the markets of Wanhsien, Chungking, and Luhsien. The Chialing River zone includes the whole of Northern Szechwan, producing about 160,000 quintals a year, for which the collection and transshipment center is Hochwan. The Wu River zone produces about 60,000 quintals a year, a small portion of which goes through Changteh, Hunan to Hankow for household use, while the greater part is directly marketed in Wanhsien or Chungking via Fowling, to be eventually sent abroad. Recent information indicates that the total tung oil production of Szechwan will be substantially amplified within a few years, for the Chinese government has started a five-year program to expand the acreage since last year.

Hunan ranks second among the producing provinces. Its annual output is 350,000 quintals, nearly one-fourth of China's total output of 1,360,000 quintals. In a normal year Hunan consumes only one-seventh of its own production and exports the remainder, largely to Hankow. The provincial government is reported to be at work to increase tung oil production and it is generally believed that within the not too distant future the production will be substantially expanded. The present production is centered along four river valleys. The first is the Yuan River section which produces about 240,000 quintals; partly gathered in Hungkiang and shipped after converting into "Hung-yu" to Chinkiang, Kiangsu for domestic use; partly assembled in Changteh or Yuanling, and thence mainly shipped to Hankow through the port of Yochow. Second, the Li River section produces yearly some 67,000 quintals, all concentrated in Tsingshih by the local merchants,

and destined for Hankow. Third, the Hsiang River section, in the south of the province, produces 29,000 quintals annually; while, fourth, the Tze River section contributes to the yield of Hunan only 6,000 quintals, both transported to Hankow through their respective gathering-markets, Changsha and Iyang.

Hupeh holds the third place in China as the tung oil producer, and has a yield of about 160,000 quintals, representing only 12 per cent of the country's total production. The local consumption is estimated to be a quarter of the amount; the remainder is exported. The chief localities in the province are the Han River Valley, the upper Yangtze Valley, and the lower Yangtze Valley. The Han River section which covers mainly the northern part of Hupeh, produces annually 100,000 quintals, which finds its market in Laohokow. The production of the upper Yangtze section is reckoned at 50,000 quintals and that of the lower Yangtze section below 10,000 quintals. Both are exported via Hankow and pass through Ichang and Shasi in the case of the former and through Wusueh in the case of the latter.

Kwangsi, which was among the provinces first to advocate tung tree planting is now the fourth major producer of tung oil. In a normal year its total production is about 150,000 quintals, representing approximately 11 per cent of China's total yield, 90 per cent of which is exported. The following figures are the amounts of yield produced in different sections of Kwangsi: the Kwei River section, 59,000 quintals; the

Distribution of Tung Oil Production.

Liu River section, 50,000 quintals; the Chuan River section, 23,000 quintals; the Yu River section, 18,000 quintals. The oil of the first three sections is gathered in Kweiling and Liuchow; that of the last named, in Nanning; all bound for Hongkong as their export market.

The production of Chekiang, under the stimulus of high prices and promotion by the local government during the pre-war years, has been substantially increased to 120,000 quintals. Consumption in the province accounts for only ten per cent of the amount, while nearly 90 per cent is exported. The important growing sections fall into two areas, the Chientang River Valley and the Ou River Valley. The first produces annually about 80,000 quintals, the greater part of which is shipped to Hangchow via Lunchi, Kienteh, Chuki, and Chüchow for export. The second covers nearly the whole of southeastern Chekiang, its yearly production approximating 40,000 quintals, all gathered at Wenchow either by boat or by coolie.

Kweichow, once the largest tung oil producing province of China has now fallen to an annual production of only 50,000 quintals and provides only four per cent of China's total production. Ninety per cent of the amount is exported abroad. As far as the tung acreage is concerned, the upper Wu River, the Chingshui River, and Southern Kweichow are the three main areas. Their average yield is over 10,000 quintals each. The Chishui River Valley comes next, with a production of several thousand quintals annually. From the upper Wu River section, oil is shipped in large quantities by boat up the Wu River to Fowling, Szechwan, whence it goes to Wanhsien or Chungking. The Chingshui River section ships its oil to Hungkiang, Hunan, for export. The oil of southern Kweichow is first assembled in Yunhsien, Kwangsi, and then shipped to Wuchow through Liuchow. That of the Chihshui River is usually shipped to Chungking via Hokiang or Kiangtsing.

Among other producing provinces Shensi wins a proper place. In this province tung trees grow chiefly in the mountainous regions along the frontiers adjoining Szechwan and Hupeh. The production in normal years is about 30,000 quintals, most of it is assembled in Ankang and shipped up the Han River to Hankow. Other regions such as the marginal area of Kiangsi, middle and southern Anwhei, southwestern Honan, northern Fukien, northern Kwangtung, and a small portion of both Yunnan and Sikiang render a total yield of 50,000 quintals, largely for local consumption.

CLIMATE

The most important factor for growth of tung trees is climate, since growth is determined by the amount of precipitations, its seasonal distribution, summer and winter temperatures, the length of the growing season and the wind direction. The tung tree is definitely limited to those areas where the annual mean precipitation varies from 700 to about 2,000 millimeters with an average precipitation of 1,300 mm. In the tung areas of Szechwan, Kweichow, Hupeh, Western Kwangsi, and a large part of Hunan the range of precipitation is from 800 to 1,499 mm. as compared with the tung areas in Chekiang and Eastern Kwangsi, which have a precipitation of over 1,500 mm. The monsoons produce plentiful precipitation in the southeastern part of China's tung region and less in the northwestern provinces.

Approximately one-half of the annual precipitation falls during the summer

months when the tung tree in well advanced growth requires abundant rainfall. The amounts in spring and autumn are about equally divided, except that Chekiang, Hunan, and Eastern Kwangsi tung regions are alike in having about twice as much precipitation in the spring as in the autumn, and the Kweichow and Szechwan regions have a little more rain in the autumn than in the spring. In the winter months when rainfall is least needed by the tung tree, about seven per cent of the yearly total falls. Rainfall concentrated in the summer months (June-August) has a significant influence upon the tung crop, and the farmers of Kwangsi speak of the formation of poor harvest of tung fruit as "drought in June," and of the poor oil content in fruit as "drought in July."

Temperature has great effects on the growth of the tung tree, and like precipitation, decreases from the southeast to the northwest throughout the whole tung area of China as the result of monsoons. The annual average temperature varies from 16 degrees C. to 22 degrees C. The 20 degree C. isotherm divides the whole tung region into two sections, namely the Aleurites fordii section on the north and the A. montana on the south. Throughout the whole region the mean January temperature is from 2 to 14.8 degrees C. as compared with the mean July temperature of 21 to 30 degrees C. The range of temperature varies from 12.5 to 24.3 degrees C. In Szechwan the tung region is protected from the Siberian and Central Asiatic influences by a circle of mountains and has a much milder winter than other provinces. Moreover, it is said that because tung trees bloom during cold weather, the Szechwan oil is in some cases of better quality than that produced in other provinces.

Tung plants are easily damaged by frost and hence can be grown only where the growing season is sufficiently long. In most parts of the tung region of China, there are about 300 frost-free days, while in some places in Szechwan, and the southern parts of Kwangsi and Chekiang the growing season is yearlong.

Winds influence to some extent the development of the tung plant, as they may do a great deal of damage during its blooming season. In China winds detrimental to the trees occur more often along the coast and are caused chiefly by typhoons which come inland from the sea, and for this reason the tung plant rarely develops along the coast in south and southeast China. In the southwest tung producing area which is located in the Interior, the blossoming of the tung tree is protected from damaging winds by a circle of mountains and hills.

SOIL

Next to climate, soil plays an important role in tung tree growth. A comparative study of the map of tung oil production and that of soil distribution shows that nearly all the tung regions in China are characterized by leached soils, which abound where the summer is long and rainfall sufficiently heavy to leach most of the lime. It is to be noted that when rainfall is so heavy that all the free lime present in the soil is leached, it also removes a large share of the soluble mineral plant foods, and the soil tends to become infertile for most plants. This is especially so on hilly and mountainous lands, so that the soil is too poor to cultivate crops other than tung. Fertility of soil is only of secondary importance in the growth of tung. They require very little care, time, and fertilizer.

In China there are five kinds of soils that fall under the heading of "leached

soils." The first is the old and young yellow earths, slightly to moderately podzolised. They are very common in the high mountains of Kweichow in western Kwangsi, western Hunan, and southern Yunnan. A few strips of this type follow the mountain ridge of the east Szechwan Basin. In general they are strongly acidic in reaction with a pH value of from 4.0 to 6.4 and are rather poor agricultural lands. Moreover, they are chiefly found in high mountains where irrigation is difficult and consequently, where good yields of other crops cannot be raised, but to which the tung tree is especially well adapted. The second kind is the purple-brown forest soils showing slightly acidic or neutral characteristics with a pH value between 6.4 and 7.3. They are peculiarly abundant in Szechwan and also occur in small areas in northern Kweichow and central Hunan, but, because of the alternating wet and dry climate of the latter provinces and perhaps also because the shales are somewhat different chemically, these soils are somewhat less productive than those of the former province.

Thirdly there are the old red earths which are slightly and moderately podzolised which occur on the low hills in eastern Kwangsi, eastern and central Hunan, central Kiangsi, and eastern Yunnan. They are highly acidic with a pH value of 4.0 to 6.4, and are extremely poor for agricultural yields, but in many places are used for and have produced fair yields of tung crops. Fourthly, the podzolised old and young red earths are most common in the low hills and mountains of south China from just north of the Yangtze River to the region of the old red earths. There are many small areas of these soils which extend southward along the seacoast to Kwangtung. Further west, small areas are scattered through Kwangsi. With a pH value of 4.0 to 6.4 these soils are much better suited to tung trees; yet they are usually much better used for rice land, when they are irrigated. Fifthly, the brown and gray-brown podzolic soils, slightly to strongly acid showing a pH value of 4.0 to 6.4 are common in the tung region of southern Shensi, western Hupeh, eastern Szechwan, and the borders of Hunan-Kiangsi, and of Fukien-Chekiang-Kiangsi. Most of them do not yield good food crops, but tung trees are well adapted to them.

NATURAL FEATURES

As has been pointed out before, nearly all tung trees are distributed over hillsides or in mountainous lands in China, for the plains are fully utilized for the production of human food. Thus topography, though less important, also constitutes one of the physical factors in the location of tung groves. Thus, the Szechwan tung region consists mainly of the "Szechwan Basin," the most famous tung region of China. The eastern third is comprised of ranges of low mountains with many rolling hills between the ranges while the western part is largely comprised of low rolling hills and buttes. In addition to the basin the area also includes on its eastern and northern borders a part of the Tapa Shen Complex, in the south part of Kweichow and Yunnan Plateaus, and in the west the Ta Hsueh Shan. The whole region lies between the 250 to the 1500 meter contour lines and there are considerable areas over 1500 meters. Other prominent tung producing areas such as Hunan and Chekiang are in the southeast Mountain Complex which is characterized by a network of mountains and hills with no broad plains and a limited amount of level land along certain rivers. Their average elevation

is from 200 to 1000 meters but in some higher western border ridges they frequently attain 1500 meters. The Kwangsi tung region may be divided into two distinct sections on the basis of topographic differences. These we may call the "Kwangsi Hills and Valleys" and the "Kwangsi Mountains." In the former the greater part is made up of hills, a few mountains, and many valleys and areas of low relief; the latter is composed of rough mountains and hills with only very narrow valleys. Both lie at an average elevation of from about 200 to 1000 meters. The whole Kweichow tung region is included in the Kweichow Plateau at an elevation of 1000 to 2000 meters, the average being about 1500 meters. Tung regions of western Hupeh and southern Shensi all lie in the Tapa Shan Complex which contains several mountain ranges, among which the Tapa Shan is the best known. A large part of the Tapa Shan has an altitude of from 1500 to 2000 meters, but its highest parts exceed 3000 meters.

WATER COMMUNICATION

Water transportation facilities also constitute a factor in influencing the location of tung oil production. Tung oil and especially tung seed from which the oil is produced is a commodity much heavier and bulkier and less valuable than many other commodities. In China the tung seed producers usually sell the bulk of their output to the local oil millers and human carrier is the only means of transportation in the first stages. After pressing, the tung oil is packed in bamboo crates or wooden barrels which are in most cases, especially in the mountainous districts, carried by man or by cart over a short distance to rivers. The oil is loaded on junks, sent to assembling markets near the river and then reshipped by steamer to the domestic market or to export markets for world distribution. Nearly all of China's tung oil is so transported. For this reason the tung groves are situated along river courses, and it is also why China's tung regions may be divided into three main systems: the Yangtze River in central and west China, the West River in south China, and the coastal rivers in southeast China.

The Yangtze River system covers the tung region of Szechwan, Hunan, Hupeh, Kweichow, and Shensi. In Szechwan it is known as the "Chwankiang" or "Szechwan River." It receives the Min River at Ipin, the Tou River at Luhsien, the Chihshui River at Hokiang, the Chialing River at Chungking, and the Wu River at Fowling. All the oils produced in those respective valleys and concentrated in these ports pass by way of the rivers through Wanhsien and Ichang to Hankow. From Hunan tung oil goes down the Hsiang, Tze, Yuan, and Li Rivers via Yochow at Tungting Lake to Hankow. The Han River is the highway for the oil produced in northwest Hupeh and southern Shensi, via Lohokow to Hankow.

The West River has several main tributaries, including the Peipang River on the Kweichow-Kwangsi border, the Kwei, Liu, and Yu River in Kwangsi, and absorbs the oil produced in these river valleys. It is navigable by steamer up to Wuchow, beyond which junks and steamers reach interior Kwangsi and Kweichow.

The coastal river system includes the Chientang River which begins in southern Anhwei and flows eastward through northern Chekiang to the East China Sea, the Ou River which springs from the mountains in southwestern Chekiang and enters the East China Sea after passing Wenchow, and

many other rivers scattered in the Fukien province and Kiangsi-Chekiang border. The oil produced in Chekiang, Anhwei, Kiangsi, and Fukien is transshipped and concentrated in Hangchow and Wenchow and sent to Shanghai overland or by water.

LEADING MARKETS

The leading ports from which tung oil was shipped in pre-war years to foreign countries were Shanghai, Hankow, and Wuchow. From Shanghai the export and transshipment of tung oil at the beginning of this century was very small and far below that of Hankow, but, owing to its central situation and exclusive shipping facilities, tung oil traders gradually came to concentrate their stock in Shanghai from Chekiang, Anhwei, and other provinces. Then the oil firms of Hankow and other markets began to send all their oil to Shanghai by steamer. This caused a considerable increase in the figures of tung oil export from Shanghai, and a corresponding decrease at Hankow which had been the greatest collecting center of tung oil of middle and west China. Wuchow has been since 1912 the collecting center of tung oil produced in south China, with Hongkong as its distributing market. In 1936, it handled about six per cent of the total quantity exported by China.

During the first four and a half years of the Sino-Japanese War, with the closure of the lower Yangtze, Hongkong superseded Shanghai as the center of the tung oil trade. The British Crown Colony, listed as a "country of destination" in the Chinese Customs Returns, was of no vital importance to oil export in the pre-war years, but became in fact the predominant port of transshipment for tung oil either for cash purchases or for the fulfillment of barter arrangements. In spite of transport difficulties considerable amounts of Chinese tung oil were concentrated in the main markets of China and then sent by the Canton-Hankow and Canton-Kowloon Railways, by the Kunmin-Haiphong route, and by the Kunnan-Burma Road to Hongkong. As shown by the Chinese Customs Returns about 82, 89, 66, and 52 per cent of China's oil export was sold through Hongkong in 1938, 1939, 1940 and the first ten months of 1941 respectively. At the same time small amounts of oil pass through via the Northwestern Highway of Russia, though no exact data have ever been released in this connection. Since Hongkong fell in 1941, tung oil has only once been exported in small quantities by air to India. The export by the Northwestern Highway, however, has not been interrupted. The revival of the export of Chinese tung oil will be possible when the Burma Road, or better, the Yangtze River is opened. In the latter case there is no doubt that the Shanghai market will again occupy a very important place in the tung oil trade between China and foreign countries.

CONCLUSION

Taking the various factors of China's tung oil production as a whole, we realize the most significant fact that the majority of the tung trees are concentrated on hillsides and in mountainous areas where the average elevation is from 200 to 2000 meters, where they have enough moisture and warmth and no winter temperature lower than a few degrees below freezing and no wind damaging to blossoms, where water transportation facilities and adequate labor is available. These conditions are favorable for the growth of tung trees and necessary for the development of a tung industry. China

is in first place in the world's tung oil production.

It is known that experimental planting or extension of tung tree plantations has been undertaken in the United States, U.S.S.R., South Africa, Australia, New Zealand, several South American countries such as Brazil, Argentina, Paraguay, Peru, and several countries in the Far East such as Burma, Malaya, Thailand, Indo-China, the Netherlands Indies. The production in most of these countries is, however, very small. Only the United States has increased its acreage and production in recent years, but her production is still only a small proportion of her consumption, being estimated at about 20,000 quintals, as against her annual import from China in 1936 and 1937 of some 600,000 quintals. This fact indicates that China is the largest tung oil producer in the world, not only in the past, but also in the near future. To meet the demands both at home and abroad, the Foreign Trade Commission started a five-year program in 1941 and made special appropriations of several million Chinese dollars annually, to improve the tung oil industry. The Commission has also established a tung oil research institute at Chungking for research work on selection of good seeds, better growing methods, improvement of oil pressing machinery and better marketing methods. Large sums of money have been granted by the Commission to aid several local organizations with the purpose of increasing the acreage of tung tree plantations. It is expected that before long China's tung oil production will be substantially above that of recent years.

CARNAUBA WAX IN UNITED STATES—BRAZILIAN FOREIGN TRADE

Grace Beckett

NOT until war-time conditions alter the customary production and shipping of commodities in foreign commerce do many people appreciate the advantages of international trade or realize their own lack of general information concerning the commodities sent from distant corners of the earth. A product heretofore infrequently mentioned is carnauba wax. This wax has been an article of commerce for decades. In recent years, however, a variety of new uses has greatly increased the demand for it and consequently enlarged the volume moving in international trade.

Carnauba wax is secured from the carnauba palm, *Copernicia cerifera*, indigenous to tropical South America. Since cultivation of this palm for wax has been relatively unsuccessful in other countries, most of the world's supply of carnauba comes from northern Brazil where the trees grow wild. In 1940 all of our imports of carnauba wax were from Brazil.

The wax forms on the fan-shaped leaves of the palm to prevent excessive evaporation of moisture in dry seasons. To remove the wax dust, some leaves are cut from the tree, dried, and scraped, or beaten. The class of wax depends upon the type of leaf cut. From the mature leaves "straw" wax is secured, and from the young leaves, "eye" wax. These waxes are melted to obtain the commercial grades of carnauba, hardened to form cakes, and then packed in heavy bags for shipping. The powder from the mature leaves melted without water produces the "North Country" grade of wax, with water, "chalky" wax; both are dark in color. The "eye" wax, when melted, yields No. 1 and No. 2 yellow wax, No. 1 being of the best quality. To secure certain grades, the wax is customarily treated with a bleaching agent, and mixed with a small percentage of paraffin wax.

To consider all the industrial uses of carnauba wax would be a tiresome project. Only a few of the more common applications need be mentioned. Perhaps most familiar is its use as a polish base; carnauba wax imparts luster to shoe, metal, floor, automobile, or furniture polish. This wax is an ingredient in the manufacture of some paints, enamels, lacquers, varnishes, and wood-finishing waxes; it gives a surface to which dust will not cling easily. Also it enters into the production of certain phonograph records, photographic film, carbon paper, soap, salve, chalk, and matches. Compositions containing the wax can stiffen cardboard containers; waterproof pasteboard, wall paper, wrapping paper, and electrical appliances; mothproof feathers, furs, skins, and leather goods; insulate electrical machinery; or seal dry-cell batteries. Candles made from it are hard and durable.

Not until about 1900 did carnauba wax definitely become an article of international commerce; before that time, much of the trade was domestic. Exports have assumed increasing importance; in recent years, approximately ninety per cent of Brazilian production

has been exported. Plantings and new extractive methods may increase the volume of production in the future. The accompanying table shows exports of carnauba wax from Brazil between 1931 and 1940. Annual shipments averaged about 17,417,400 pounds during this period, with an average annual value of $4,411,200. For the last two or three decades the United States has been the leading importer. We took between fifty and seventy-five per cent of total Brazilian exports of carnauba wax during the years 1931 to 1939. Thereafter the proportion shipped to us increased with the loss of European markets.

Export duties are levied on carnauba wax by various Brazilian states among which are Bahia, Ceara, Maranhao, Matto Grosso, Parahyba, Pernambuco, and Rio Grande do Norte. These duties are usually on an *ad valorem* basis and apply to both interstate and foreign commerce. The Brazilian Federal Government, in addition, under provisions of standards specifications, makes

CARNAUBA WAX

UNITED STATES-BRAZILIAN TRADE

1931–1940

A.

IMPORTS OF CARNAUBA WAX INTO THE UNITED STATES

Year	FROM ALL COUNTRIES		FROM BRAZIL		United States Imports from Brazil as Percentage of Total United States Imports (Per cent)
	Quantity (1,000 pounds)	Value (1,000 dollars)	Quantity (1,000 pounds)	Value (1,000 dollars)	
1931	7,447	1,070	7,389	1,053	98.4
1932	6,166	733	6,166	733	100.0
1933	7,720	970	7,720	970	100.0
1934	7,842	1,528	7,842	1,528	100.0
1935	10,421	2,789	10,143	2,686	96.3
1936	12,500	4,286	12,465	4,278	99.8
1937	13,916	4,801	13,911	4,800	99.9
1938	12,377	3,927	12,344	3,916	99.7
1939	16,359	4,928	16,352	4,927	99.9
1940	16,926	7,808	16,926	7,808	100.0

B.

EXPORTS OF CARNAUBA WAX FROM BRAZIL

Year	Quantity (1,000 pounds)	Value (1,000 dollars)	United States Imports from Brazil as Percentage of Total Brazilian Exports (Per cent)
1931	16,471	1,671	63.0
1932	14,065	1,416	51.8
1933	15,157	1,698	57.1
1934	13,549	2,309	66.2
1935	14,566	3,168	84.8
1936	19,343	6,376	67.1
1937	19,714	6,609	72.6
1938	20,190	5,858	66.8
1939	22,048	6,536	75.4
1940	19,071	8,471	92.2

Source: Assembled and computed on the basis of data contained in United States Department of Commerce, Bureau of Foreign and Domestic Commerce, *Foreign Commerce and Navigation of the United States, Monthly Summary of Foreign Commerce, Foreign Commerce Yearbook.*

charges for the inspection, classification, and certification of carnauba wax shipments. As provided in the Tariff Acts of 1913, 1922, and 1930 carnauba wax has entered the United States duty free. This duty-free status was bound in the United States–Brazilian reciprocal trade agreement, effective January 1, 1936.

Carnauba wax is an example of product of which the main or only source of supply is concentrated in one geographical region. Although a few other vegetable waxes have appeared on the market as potential substitutes, no rival has, as yet, seriously challenged the significant position of carnauba.

AN ISARITHMIC-DOT POPULATION MAP

John W. Alexander

THE two most common symbols employed in the mapping of population distribution are isarithms and dots. Each of these has advantages, but there also are disadvantages which leave something to be desired in each type of map. However, these disadvantages are not mutual but are complementary to each other.

1. *Isarithms:* One advantage of isarithms is that they allow one to read directly from the map the number of people in an area. Since, on population maps, isarithms are usually lines delimiting ratios (population density), they are most satisfactory for maps of areas where the important thing is the ratio of number of people to the area that they occupy—in other words, for regions of *dispersed* population.

Isarithms do not satisfactorily treat *agglomerated* populations for a number of reasons. (a) The important thing about an agglomeration is the actual number of people in it rather than its density. For instance, in a region of dispersed population a city of 50,000 spread over four square miles and another city of 50,000 occupying eight square miles are equally important as clusters of people, yet an isarithmic map would render the first much more conspicuous than the second because its density is twice as great. (b) From an isarithmic map one cannot determine the actual population of an urban unit. (c) The fact that isarithms are lines across the map means that they show gradual transitions better than abrupt changes in densities. The transition in density from rural to urban areas is not gradual but abrupt; isarithms are not adapted to showing such a change very satisfactorily. (d) On an isarithmic map a large city surrounded by dispersed population would be represented by numerous concentric isarithms. This is especially true on maps where the areal units are small enough to bring out sharply the contrast between densities of urban and adjoining rural localities. These "peaks" of concentric isarithms coinciding with urban agglomerations interrupt the general patterns on the map and make it difficult to get a clear picture of population distribution—they clutter up the map.

It can be concluded that isarithms represent dispersed population better than they do agglomerated.

2. *Dots:* A dot map is the best map for showing the *pattern* in which population is scattered over an area. However, there are some disadvantages in using dots. (a) One cannot tell from a dot map whether a dot represents dispersed population or a small agglomeration. For instance, on a large-scale dot map where one dot equals 500 people one cannot ascertain whether a certain dot represents 500 scattered people or a village of 500 inhabitants. (b) The placing of dots is a difficult task especially in areas of dispersed population where each dot represents a large number of people scattered over an area larger than that actually covered by the dot on the map. One must decide where within those areas to place the dots. No matter where the dots are located, a false impression is given of population being clustered

around the dots with intervening blank areas, when actually the population may be thinly but evenly distributed over the entire region. (c) There is a tendency in areas of dispersed population to concentrate the dots along rivers, railroads, and highways. Thus, transportation lines sometimes are falsely emphasized.

From these considerations it is seen that there are fundamental weaknesses in representing dispersed population by the dot method. Since a dot pattern is simply clusters of ink with intervening spaces, such a symbol is best adapted for representing clustered or agglomerated population.

The two types of population (agglomerated and dispersed) are different in many ways; it is therefore desirable to use a distinct symbol for each. It has been observed that dots are better for agglomerated population; isarithms are better for dispersed. Thus, the most advantageous method of mapping population would be to show dispersed population by means of isarithms first and then superimpose on this structure a graduated dot pattern to indicate the location of agglomerations, each dot corresponding in size to the number of inhabitants in the unit represented. The advantages of such a map are: (a) The two distinct types of population are represented by different symbols. (b) Each dot is an agglomeration. (c) There is no false concentration of dots along transportation lines.

The difficulties involved in constructing this type of map are reflected by the following questions: Where, at the periphery of metropolitan areas, does agglomerated population terminate and dispersed population begin? Outside the city limits of most large cities are areas of settlement almost as compact as the adjoining parts of the city. Should such settlements be included in the agglomeration or should they be shown as dispersed population with a high density? Again, how small can a cluster of people be and yet be represented as an agglomeration? The answer to this question depends on the scale of the map and the scale of the dots; the larger the scale of the map, the smaller can be the units that are shown as dots.

Yet with these limitations, this type of map—dots on an isarithmic background—has advantages which make it effective.